22nd January
2025

8th Hungarian Neuroscience Meeting for
Undergraduate Students, Graduate Students
and Young Postdocs

# 8th HuNDoC Meeting Debrecen 2025

hundoc2025.mitt.hu

University of Debrecen, Learning Center
(Debrecen, Egyetem tér 1., 4032)

# INVITATION

We, the organizing committee, gladly announce the **8th Hungarian Neuroscience Doctoral Conference (HuNDoC 2025)**, hosted by the University of Debrecen, Hungary, in one of Europe's fastest developing cities. Respecting conventions, the meeting will take place one day prior to the annual conference of the Hungarian Neuroscience Society (MITT 2025) serving as its satellite event, on January 22nd, 2025.

We warmly welcome undergraduates, PhD students and Junior Postdoctoral colleagues to share their promising research, or even just a simple but leading idea at this vibrant forum. It will be a fun day filled with inspiring talks, inviting company and later in the day an exciting workshop as well. By recognizing the difficulties of self-management in academic life we hope to establish a new custom for HuNDoC by inviting the leading expert of this field as the plenary lecturer. Professor Robert Harris is an experienced researcher of immunotherapy in neurological diseases at the Karolinska Institute, Sweden, and the Academic Vice-President of Doctoral Education as well.

Every applicant is kindly requested to submit an abstract at the time of registration, of which sixteen oral presenters will be selected by the organizing committee for long (10 min) or short (3 min) talks. Nevertheless, everyone deserves spotlight, for that the 'A4 Mini Poster' session will provide a great platform to connect young fellows of similar fields.

During the afternoon, we are preparing a new kind of program for you. We organize a hackathon, where divided into teams, you can work on a practical solution to a specific problem and come up with new ideas together.

This day will provide You with more than just science! A social event in the city-wise known Klinika Egyetemi Klub will offer us a friendly atmosphere to further discuss conclusions of the day and perhaps to also meet new friends.

For any further questions, please do not hesitate to contact us at hundoc2025@gmail.com.

We are excited to have you on board for HuNDoC 2025!

With kind regards from
**The organizing committee**

# General Information

**Date:** 22 January 2025

**Venue:** Learning Center, Debrecen, Egyetem tér 1., 4032

**Organizers:**

- László Ducza, Department of Anatomy, Histology and Embryology, Faculty of Medicine, University of Debrecen
- Botond Gaál, Department of Anatomy, Histology and Embryology, Faculty of Medicine, University of Debrecen
- Lídia Gömöri, Department of Anatomy, Histology and Embryology, Faculty of Medicine, University of Debrecen
- Péter Szücs, Department of Anatomy, Histology and Embryology, Faculty of Medicine, University of Debrecen

**Website:**

hundoc2025.mitt.hu

**Contact us:**

hundoc2025@gmail.com

# VENUE

**Learning Center**

(University of Debrecen)

**Address:** 4032 Debrecen, Egyetem Tér 1.




**Public transportation:**

- Tram 1 (stop: Egyetem)
- Tram 2 (stop: Csokonai Vitéz Mihály Gimnázium)
- Bus 12, 22, 23, 23Y, 24, 51E, 73, 73A (stop: Dóczy József utca)
- Bus 10, 10Y, 22Y, 52E, 92, 93 (stop: Sportkollégium)

# SCIENTIFIC PROGRAM

**Scientific Program**

Our program includes one plenary lecture by Professor Robert Harris, researcher of immunotherapy in neurological diseases at the Karolinska Institute, Sweden, and the Academic Vice-President of Doctoral Education as well, two sessions of oral presentations (3 minute thesis and 10 minute oral presentations) by selected speakers and a MiniPoster session in the afternoon. After that, divided into groups participants take part in a hackathon, the topic of which will be revealed on the morning of the conference. Please note that the official language of the conference is English. All presentations must be prepared accordingly.

**Oral presentations**

- 3 minute thesis:

Presenters selected for 3 minute oral presentation must prepare a slide show of maximum 3 slides (preferred format: MS PowerPoint). Each presentation is followed by 1 question from the audience.

- 10 minute oral presentation:

Presenters must prepare a slide show (preferred format is also MS PowerPoint) in which they present their work in 10 minutes. Each presentation is followed by a 5 minute discussion.

The necessary tools for the presentation will be provided. Please upload your presentations on the provided computer at least 10 minutes before your session starts, or send it in email to hundoc2025@gmail.com until 23:59, 20th January 2025.

We ask the presenters to keep the time limits strictly.

## Poster session

All registered participants, who submitted an abstract, must prepare a mini-poster (A4 size), except for those who were selected for oral presentation. Poster presenters will be assigned to groups of 4-6 and each participant will present their work to the others in the group in a less formal manner.

Ideal mini-posters are not shrunk versions of regular scientific posters. Keep text as little as possible, present the most essential data only. Keep in mind that there might be significant differences in scientific background and career stage among group members within each group.

Poster session will take place at 14:00 for 60 minutes. During this time, all participants should present their poster in the group. Please respect other group members' time: try to save time for others to present their work and leave room for discussion.

Digital posters are permitted, but technical support (e.g. tablets) for these will not be provided.

## Hackathon

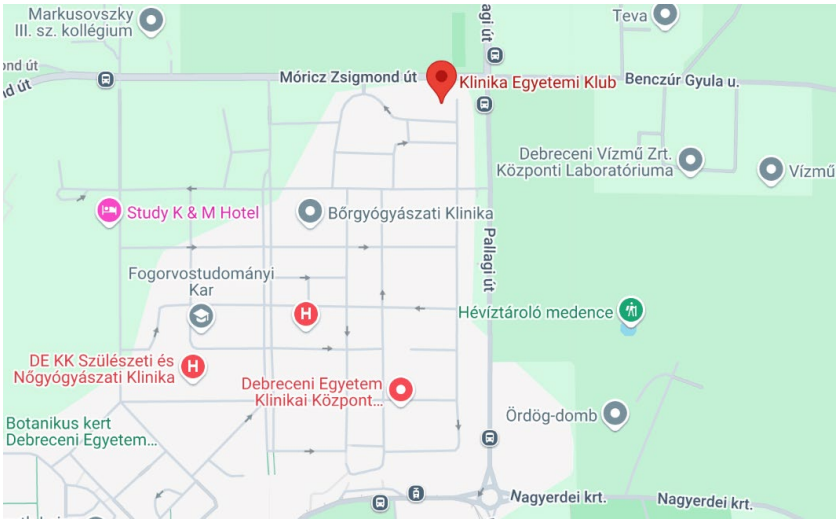
During the afternoon a Hackathon will take place. For detailed information, please visit the Hackathon section.

# SOCIAL EVENT

The evening social event will take place in the Klinika Egyetemi Klub for registered HuNDoC2025 participants only. Please bring your neck passes with you.

The gathering in Klinika Klub starts at **19:00.**

**Address:** Debrecen, Egyetem tér 1, 4032




**The event will start with the closing ceremony of the Hackathon from 19:30, where each team should present their solutions and results in a short pitch.**

Join the Spotify playlist and add your favourite tracks for the party!

Use the actual link at the program page of the website!

(https://hundoc2025.mitt.hu/programme/program)

# PROGRAM OVERVIEW

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|---|---|---|
| 8:00 – 9:00 | **Registration** | Learning Center (LC) main hall |
| 9:00 – 9:15 | **Welcome speech** | LC 0.14 lecture hall |
| 9:15 – 10:00 | **Plenary Lecture**<br>**Robert Harris**<br>(Professor, Academic vice president, Docent - Karolinska Institutet)<br>**Professional responsibilities of PhD supervisors and PhD students** | LC 0.14 lecture hall |
| 10:00 – 11:15 | **Session I.** | LC 0.14 lecture hall |
| 11:15 – 11:45 | **Coffee break** | LC main hall |
| 11:45 – 13:00 | **Session II.** | LC 0.14 lecture hall |
| 13:00 – 14:00 | **Lunch** | LC main hall |
| 14:00 – 15:00 | **Mini Poster Section** | LC 0.14 lecture hall, main hall |
| 15:00 – 16:20 | **Hackathon – Round I.** | LC 0.14 lecture hall, main hall |
| 16:20 – 16:40 | **Coffee break** | LC main hall |
| 16:40 – 18:00 | **Hackathon – Round II.** | LC main hall |
| 19:00 – 19:30 | **Social Event** – Gathering in Klinika Klub | Klinika Egyetemi Klub |
| 19:30 – 20:00 | **Hackathon pitches** | Klinika Egyetemi Klub |
| 20:00 – | **Party** | Klinika Egyetemi Klub |

# DETAILED PROGRAM

**8:00 – 9:00 – Registration** (registration site will be available until 11 o'clock)

**9:00 – 9:15 – Welcome speech**

**9:15– 10:00 – Plenary Lecture**

**Robert Harris**
Professor, Academic vice president, Docent - Karolinska Institutet
**Professional responsibilities of PhD supervisors and PhD students**

**10:00 – 11:15 – Session I.**

10 minute presentations:

- *10:00*
  **Joanna Grace Sandle (University of Szeged, Department of Physiology, Anatomy and Neuroscience)**
  Group I mGluR mediated changes in neuronal excitability and synaptic strength show cell-type specificity
- *10:15*
  **Zuhao Cui (HUN-REN Biological Research Centre, Institute of Biophysics)**
  Effect of the histone deacetylase inhibitor SAHA on the gene expression of brain endothelial cells after ischemic injury
- *10:30*
  **Tamás Láng (Semmelweis University, Department of Anatomy, Histology and Embryology)**
  Thalamo-preoptic projection controlling social isolation-induced aggression

3 minute theses:

- **Máté Egyed (Eötvös Loránd University, Department of Physiology and Neurobiology)**
  Oxytocin receptor-expressing neurons in the medial preoptic area affect social behavior in rats

- **Victoria Lyakhova (Institute of Experimental Medicine, Lendület Laboratory of Systems Neuroscience)**
  THE INVOLVEMENT OF CHOLINERGIC LATERAL SEPTUM NEURONS IN PROCESSING FEAR-INDUCING AND SOCIAL OLFACTORY CUES IN MALE AND FEMALE MICE
- **Melinda Rácz (HUN-REN Research Centre for Natural Sciences, Institute of Cognitive Neuroscience and Psychology)**
  Physiological assessment of the psychological flow state using wearable devices
- **Nishitani Mika (University of Debrecen, Department of Anatomy, Histology and Embryology)**
  Temporal Integration of Late-Born Neurons Populating the Sensory Circuits in the Mouse Spinal Cord and Brainstem Revealed by In Utero Electroporation
- **Evelin Szabó (University of Pécs, Institute of Physiology)**
  Modifying effects of testing conditions in metabolic stress studies

**11:15 – 11:45 – Coffee break**

**11:45 – 13:00 – Session II.**

10 minute presentations:

- *11:45*
  **Szilárd Szőcs (University of Pécs, Institute of Physiology)**
  Characterisation of the CCK-positive inhibitory cells in the medial entorhinal cortex
- *12:00*
  **Csenge Sólyomvári (University of Pécs, Medical School, Institute of Physiology)**
  Protective effects of dehydroepiandrosterone on glia cells and the cholinergic system in a neurotoxic Alzheimer's disorder mouse model
- *12:15*
  **Daniel Kimsanaliev (Eötvös Loránd University, Department of Physiology and Neurobiology)**
  Age-dependent role of Caskin scaffold proteins in anxiety and repetitive behaviour

3 minute theses:

- **Alistair Todd (University of Debrecen, Department of Anatomy, Histology and Embryology)**
  The neurons in the spinocerebellar and pontocerebellar circuits share a common birthday.

- **Márton Huszár-Kis (University of Szeged, Department of Physiology)**
  Improving real-time epileptic seizure detection using light-weight deeplearning
- **Tamara Hajdu (Semmelweis University Doctoral College, Department of Anatomy, Histology and Embryology)**
  Gene expression analysis in the parahippocampal cortex of individuals who died by suicide
- **Kinga Vörös (Semmelweis University, Translational Medicine Institute)**
  Felodipine efficiency analysis on induced neurons derived from Huntington's disease FELL-HD clinical trial patients
- **Zsófia Balogh-Lantos (Pázmány Péter Catholic University, Faculty of Information Technology and Bionics)**
  Cell- and layer-specific roles of TRPV1 ion channels in infrared neurostimulation: Insights from High-Density Laminar Recordings in the Mouse Neocortex

**13:00 – 14:00 – Lunch** (Provided by the Zing Korean Restaurant)

**14:00 – 15:00 – Mini Poster Section**

**15:00 – 16:20 – Hackathon - Round I.**

- 15:00 – 15:20 – Introduction: Péter Illés (Life & Business Coach)
- 15:20 – 16:20 – Teamwork

**16:20 – 16:40 – Coffee break**

**16:40 – 18:00 – Hackathon - Round II.**

**19:00 – – Social Event in Klinika Egyetemi Klub**

- 19:00 – 19:30 – Gathering in Klinika Klub
- 19:30 – 20:00 (might be extended) – **Hackathon pitches**
- 20:00 – PARTY

# PLENARY LECTURE

## Robert Harris

*Professor, Academic vice president, Docent – Karolinska Institutet*

### Professional responsibilities of PhD supervisors and PhD students

Central to a successful PhD experience is the understanding of mutual expectations between PhD student and supervisor, as well as agreement on shared and individual professional responsibilities. In this workshop we will address the individual and shared responsibilities related to the design, conduct and monitoring of PhD education. Practical tips for getting the most out of a doctoral education will be presented.

# Session I.

10 minute
oral presentations

Session I. – 10 minute presentation

Joanna Sandle

## Group I mGluR mediated changes in neuronal excitability and synaptic strength show cell-type specificity

Joanna Sandle [1], Gábor Molnár [1], Martin Tóth [1], Katalin Ágnes Kocsis [1], Pál Barzó [2], Karri Lamsa [1 3]
Gábor Tamás [1]

*1 University of Szeged, Department of Physiology, Anatomy and Neuroscience*
*2 University of Szeged, Department of Neurosurgery*
*3 Hungarian Centre of Excellence for Molecular Medicine Research Group for Human neuron physiology and therapy*

Group I mGluRs are perisynaptic receptors composed of mGluR1 and 5 that are predominantly activated following intense presynaptic firing. They have been implicated in various physiological processes such as regulation of REM and NREM sleep as well as numerous neurodegenerative diseases such as Alzheimer's and Fragile X syndrome. However, their specific effects on different cell types and synaptic connections remain poorly understood in the human brain.

To investigate the effects of mGluRs on excitatory synaptic transmission and neuronal excitability, we used dual whole cell patch clamp to simultaneously record mono- and disynaptically connected human supragranular cortical pyramidal cells (PC) and interneurons (IN) before and after pharmacological activation of mGluR1/5 by DHPG.

We separated fast-spikers (FS) from non-fast spikers (non-FS) based on their electrophysiological properties. We observed the potentiation of excitatory postsynaptic current amplitudes (EPSCs) in the majority of FS cells, while synaptic strength of non-FS Ins remained mostly unaffected by the agonist. These results in monosynaptic transmission did not translate into significant modulation of disynaptic connections. We found differences between neuron populations in their membrane potential changes measured either directly or through monitoring of holding currents. In human FS INs, the agonist caused a non-significant reduction in holding currents indicating the depolarization of these INs, while in non-FS INs, it led to a non-significant increase in holding currents. Additionally, in human PCs, DHPG induced a significant depolarization, which is consistent with our results from the rodent cortex.

Our results point to the cell-type specific modulation of group I mGluR in the human cortex, which alters the role and function of GABAerg neurons within L2/3 microcircuits, with possible implications for both basic research and potential therapeutic strategies targeting these receptors.

Session I. – 10 minute presentation

Zuhao Cui

## Effect of the histone deacetylase inhibitor SAHA on the gene expression of brain endothelial cells after ischemic injury

Zuhao Cui [1 2], Anikó Szecskó [1 2], Koppány Párdi [1], László Dér[3], Krisztina Nagy[3], Mária A. Deli [1], Szilvia Veszelka [1]

*1 Biological Barriers Research Group, Institute of Biophysics, HUN-REN Biological Research Centre, Szeged, Hungary*

*2 University of Szeged, Szeged, Hungary*

*3 Biophotonics and Biomicrofluidics Research Group, Institute of Biophysics, HUN-REN Biological Research Centre, Szeged, Hungary*

Ischemic stroke is a leading cause of mortality and disability worldwide, resulting from the sudden interruption of blood flow to the brain. This condition leads to extensive neuronal damage and dysfunction of the blood-brain barrier (BBB), which is responsible for maintaining of the brain homeostasis. The breakdown of the BBB during ischemic stroke exacerbates brain injury by allowing the infiltration of harmful substances and immune cells into the brain parenchyma. There are currently no approved therapies specifically aimed at restoring BBB integrity after ischemic stroke. This highlights an urgent need for innovative treatments to mitigate BBB disruption and improve patient outcomes. According to our ongoing study, a histone deacetylase inhibitor: suberoylanilide hydroxamic acid (SAHA) is able to prevent the BBB functions by increasing the resistance, and decreasing the permeability of marker molecules across the BBB.

To gain a more detailed understanding of the mechanisms of SAHA, we conducted RNA-Seq analysis to explore its specific impact on the human stem cell-derived brain endothelial cells which were collected from four parallel groups: normoxia; oxygen-glucose deprivation (OGD); reoxygenation after OGD (OGD/R) and SAHA treatment during reoxygenation (OGD/R+SAHA). The results showed that SAHA treatment during reoxygenation enhanced the expression of genes of basement membrane components and modulated key angiogenesis pathways by inducing Wnt signaling and inhibiting the DLL4-NOTCH signaling pathway, which balances vascular growth and branching. After morphological analysis, we also showed that SAHA treatment led to a more elongated and differentiated brain endothelial phenotype.

Our findings suggest that SAHA could be a promising therapeutic approach for protecting brain endothelial cells after ischemic stroke.

Session I. – 10 minute presentation

Tamás Láng

## Thalamo-preoptic projection controlling social isolation-induced aggression

Tamás Láng [1], Botond Drahos [1], Ingrid Csordás [1], Vivien Szendi [2], Dávid Keller [1 3], Valery Grinevich [4], Árpád Dobolyi [1 2]

*1 Laboratory of Neuromorphology, Department of Anatomy, Histology and Embryology, Semmelweis University, Budapest 1094, Hungary*
*2 Laboratory of Molecular and Systems Neurobiology, Department of Physiology and Neurobiology, Eötvös Loránd University, Budapest 1117, Hungary*
*3 Institute for Systems Physiology, Faculty of Medicine, University of Cologne, Cologne 50931, Germany*
*4 Department of Neuropeptide Research in Psychiatry, Central Institute of Mental Health, University of Heidelberg, Mannheim 68159, Germany*

Lack of social interaction has been demonstrated to induce aggressive behaviour. In our previous research, we demonstrated that the posterior intralaminar thalamus (PIL) increases positive valence social contacts. The present study aimed to elucidate the role of the PIL-MPOA pathway and the VMH to PIL projection in the induction of aggressive behaviour in male rats subjected to social isolation. To manipulate PIL neurons that are activated by social interaction, we employed the vGATE protocol. This permitted the expression of DREADDs in PIL neurons that had previously been c-Fos activated in response to social interactions. The stimulation of vGATE-tagged PIL neurons reduced aggressive behaviour, whereas the inhibition of these neurons was found to increase aggression. The use of c-Fos immunolabeling revealed that stimulation of vGATE-labeled PIL neurons activated the MPOA neurons. In turn, the inhibition of PIL reduced c-Fos expression during aggression in the MPOA. To investigate the PIL-MPOA pathway, viruses expressing DREADDs were injected into the PIL and intracerebral cannulas were implanted above the MPOA. This allowed us the selectively manipulate the terminal fibers originating from the PIL in the MPOA region through local CNO administration. Stimulation of this neural pathway also reduced aggression, while its inhibition increased it. In addition, the role of VMH-PIL projections in aggressive behavior was investigated, and it was found that the activation of this pathway increased aggressive behaviour. We found that neurons in the MPOA reached by the PIL express oxytocin receptors (OTR). We inhibited the MPOA OTR neurons and observed an increase in aggression. In conclusion, the activation of PIL neurons leads to the inhibition of aggressive behaviour through their projections to MPOA. This may contribute to the prevention of aggressive behavior through social interaction. Meanwhile, the projections of VMH neurons may counteract this prosocial effects.

# Session I.

3 minute theses

Session I. – 3 minute thesis

Máté Egyed

## Oxytocin receptor-expressing neurons in the medial preoptic area affect social behavior in rats

Máté Egyed [1], Lilla Radvan [1], Vivien Szendi [1], Gina Puska [1 2], Valery Grinevich [3], Árpád Dobolyi [1]

*1 Department of Physiology and Neurobiology, Eötvös Loránd University, Budapest, Hungary*

*2 Department of Zoology, University of Veterinary Medicine Budapest, Budapest, Hungary*

*3 Department of Neuropeptide Research in Psychiatry, Central Institute of Mental Health, University of Heidelberg, Mannheim, Germany*

Oxytocin is released during social interactions, acts through oxytocin receptors (OTRs) to regulate social behavior. The medial preoptic area (MPOA) of the hypothalamus, rich in OTR+ neurons, and is known for its role in reproductive behavior and is increasingly recognized for its involvement in affiliative social behavior. This study aimed to investigate the functional role of MPOA OTR+ neurons in social behavior. MPOA OTR+ neurons were selectively stimulated by chemogenetics in OTR-Cre female rats. Adeno-associated virus (AAV) expressing excitatory designer receptor (DREADD) in a Cre-dependent manner was injected into the MPOA. Following the stimulation of OTR+ neurons through the injection of the DREADDs ligand clozapine-N-oxide (CNO), a significant increase was observed in the number and duration of the following behavioral elements: allogrooming, body sniffing, mounting, and chasing as compared to the previous and subsequent control days. A significant reduction of non-social behaviors was observed. A control group of rats were injected with AAV expressing a construct without the DREADD, their behavior was not affected by CNO treatment. Furthermore, CNO treatment did not alter the animals' sociability, social preference, depression-, and anxiety-like behavior in both groups. Using fiber photometry, we found that MPOA OTR+ neurons are activated during anogenital sniffing. Finally, the projections of MPOA OTR+ neurons were mapped by viral tract tracing demonstrating projections to multiple brain regions, including the periaqueductal grey matter (PAG), and the lateral septum (LS), both are implicated in the control of social behavior. We also showed that OTR+ MPOA neurons are innervated by parathyroid hormone 2 containing terminals ascending from the thalamus, which relay touch-related signals during direct social interactions. These data suggest that MPOA OTR+ neurons may facilitate social interactions between adult females via projections to the PAG and the LS.

Session I. – 3 minute thesis

Victoria Lyakhova

# THE INVOLVEMENT OF CHOLINERGIC LATERAL SEPTUM NEURONS IN PROCESSING FEAR-INDUCING AND SOCIAL OLFACTORY CUES IN MALE AND FEMALE MICE

Victoria Lyakhova [1 2], Dániel Schlingloff [1], Ágnes Simon [1], Balázs Hangya [1]

*1 Institute of Experimental Medicine, Lendület Laboratory of Systems Neuroscience, Budapest, Hungary*
*2 Doctoral College, Semmelweis University*

INTRODUCTION

The lateral septum (LS) plays a key role in regulating emotional states like anxiety and aggression and influences social behaviors, potentially in a sex-specific manner. Despite strong evidence supporting these functions, its precise mechanisms remain unclear due to conflicting findings. Traditionally viewed as purely GABAergic, our research has identified a subset of LS cells expressing cholinergic markers.

AIMS & METHODS

This study investigates the function of LS cholinergic neurons (LSCNs) by exploring their neuronal activation patterns in response to olfactory stimuli. Using the fox odour test and male urine samples combined with c-Fos staining, we quantify the overlap of activated cell populations. Furthermore, the activation of somatostatin (SOM) terminal-receiving cells were also investigated.

RESULTS AND CONCLUSIONS

We found that a significant proportion of LSCNs receive input from somatostatin terminals. Predator odour exposure led to stronger LSCN activation in females, while males exhibited greater activation of SOM input-receiving neurons in response to the olfactory cue. In contrast, exposure to darcin resulted in higher LSCN activation in males compared to females.

We plan to expand our research by adding more noxious and social cues to investigate the functional involvement of LSCN. Our research will also explore their impact on emotional regulation, social behavior, and cognitive function in both healthy and dementia mouse models by using chemogenetics and fiber photometry.

FUNDING

This research was supported by the HUN-REN, the National Research, Development and Innovation Office (NKFIH K135561, NKFIH K147097), the Hungarian Brain Research Program 3.0 (NAP2022-I-1/2022) and LP2024-8/2024.

Session I. – 3 minute thesis

Melinda Rácz

## Physiological assessment of the psychological flow state using wearable devices

Melinda Rácz [1 2 3], Tímea Magyaródi [4 5], Gergely Kitta [4], Márton Szuromi [4], Gergely Márton [1]

*1 Institute of Cognitive Neuroscience and Psychology, HUN-REN Research Centre for Natural Sciences, Budapest, Hungary*
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*4 Mathias Corvinus Collegium, Budapest, Hungary*
*5 Faculty of Education and Psychology, Eötvös Loránd University, Budapest, Hungary*

Flow is the state of optimal experience which can lead to outstanding performance. Our study demonstrates the feasibility of detecting and monitoring flow using wearable devices.

28 adult Hungarian people took part in the experiment. They performed a computer game on three different levels to induce flow and antiflow states, which we tested by questionnaires. We measured electroencephalography (EEG), heart rate (HR), blood oxygen saturation (SpO2) and galvanic skin response (GSR) signals and head and hand motion. We isolated EEG delta, theta, alpha and beta band power, HR, SpO2 and GSR average and standard deviation, and acceleration and angular velocity standard deviation.

In flow condition, alpha and theta power were the dominant components, in accordance with the transient hypofrontality hypothesis. We also replicated the U-shaped characteristic of the heart rate variability; in addition to this, we propose a U-shaped and an inverse U-shaped characteristic for SpO2 and SpO2 variability, respectively. Based on motion tracking, subjects were the least physically active in flow, signifying a focused state, and the most active in boredom.

Our results support the applicability of lightweight, wearable devices for mental state monitoring that can be utilized for the improvement of well-being at the workplace or in everyday situations.

Session I. – 3 minute thesis

Nishitani Mika

## Temporal Integration of Late-Born Neurons Populating the Sensory Circuits in the Mouse Spinal Cord and Brainstem Revealed by In Utero Electroporation

Nishitani Mika [1], Alistair Mackenzie Todd [1]

*1 Department of Anatomy, Histology and Embryology, Faculty of Medicine, University of Debrecen*

The dorsal horn of the spinal cord has a specialized circuit that processes and relays pain-related information. This circuit is made up of neurons that are among the last to be born during neurogenesis, and they differentiate into an inhibitory and excitatory neuronal population. They form a functional circuit that transmits pain-related information to higher brain regions such as the brainstem reticular formation and the thalamus. Our study aimed to learn more about the birth interval of these brainstem neurons. That is, our goal was to identify those neurons in the brainstem that are born at the same time as the spinal nociceptive neurons. To this end, we labeled the neurons in the brainstem and the spinal cord with GFP on the 12.5th day of gestation (E12.5) by in utero electroporation. After a one-month postnatal period (p28), mice were sacrificed and fixed with transcardial perfusion with paraformaldehyde. For histological analyses, coronal free-floating serial brain sections were subjected to immunohistochemistry, specifically targeting labeled neuroprogenitor cells using anti-GFP antibodies. The Allen Brain Atlas was utilized for identification of mature cells derived from labeled neuroprogenitors. Microscopic examination of brain sections demonstrated the integration of late-born neurons into major sensory pathways, including the Dorsal Column-Medial Lemniscal (DCML) pathway, spinothalamic tract, spinal trigeminal pathway, pain modulatory pathways, as well as auditory and visual pathways. These results augment our understanding of the formation of distinct sensory networks among neurons born at the same developmental time point.

Session I. – 3 minute thesis

Evelin Szabó

## Modifying effects of testing conditions in metabolic stress studies

Evelin Szabó [1] , Prabhat Kumar [1] , Anita Kovács [1] , Dóra Zelena [1]

*1 Institute of Physiology, University of Pécs, Medical School, Szentágothai Research Center, Pécs, HUngary*

INTRODUCTION: Animal models are frequently used for researching the underlying patomechanisms of metabolic diseases such as diabetes. Similarly to human diagnostics, in rodents a glucose tolerance test can be applied via intraperitoneal glucose injection. For this 120 minute-long test the use of anaesthetics can be considered. Nowdays isoflurane anaesthesia is becoming the most popular choice of anaesthetic in preclinical settings. Based on the litarature, the effect of isoflurane on the hypothalamo-hypophyseal-adrenal (HPA) axis seems contradictory. Moreover sex, fasting and the time of testing can also influence both blood glucose and stress hormone levels. These factors have already been investigated by themselves, but their combined effect is unknown.

METHOD: We investigated the effect of isoflurane anaesthesia, sex, length of fasting and the testing time on blood glucose and stress hormone levels in Sprague-Dawley rats.

RESULTS: Isoflurane anaesthesia had similar effects on the HPA axis hormones as the well-known stressor, restraint. Longer anaesthesia time in males resulted in a higher adrenocorticotropic hormone-levels (ACTH levels). Sex, fasting and the time of testing combined with a fast acting insulin treatment had no combined effect on blood glucose or stress-hormone levels, however all fasted and insulin-treated groups had significant ACTH elevation. Testing these factors in a glucose tolerance test revealed interesting differences such as a worsened glucose tolerance in males when tested at night (in inactive period) and in females tested during daytime (in their active period).

DISCUSSION: The extensive results of these experiments might contribute to better experimental designs in rodent metabolic stress studies.

# Session II.

10 minute
oral presentations

Session II. – 10 minute presentation

Szilárd Szőcs

## Characterisation of the CCK-positive inhibitory cells in the medial entorhinal cortex

Szilárd Szőcs [1], Áron Olivér Kolozsvári [1], Nóra Henn-Mike [1], Ágnes Agócs-Laboda [1], Klaudia Barabás [1], Barnabás Rozmán [1], Zsuzsanna Erdélyi[2], Ferenc Erdélyi[2], Csaba Varga [1]

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Perisomatic inhibition is considered as one of the most effective regulator in neuronal circuits. Two types of basket cells target the perisomatic regions of principal cells: fast-spiking parvalbumin-expressing and regular-spiking CCK-positive interneurons. In the entorhinal cortex parvalbumin-positive fast-spiking basket cells have been shown to play a major role in forming grid-like firing of layerII principal cells. Little is known, however, about the CCK-positive basket cells in this brain region. This lack of knowledge is mostly due to the heterogeneous expression of CCK throughout different neuronal types, including pyramidal cells. This expression pattern made the transgenic approaches for specific cell-type labeling extremely difficult. Here, with the help of a VGAT-IRES-Cre/BAC-CCK-eGFP-coIN transgenic mice we show the overall distribution of CCK+ interneurons and their specific targets in the medial entorhinal cortex. We found that the targets of the CCK-positive basket cells often show layer selectivity and cell-type specificity. Moreover, we found that layerI CCK-positive GABAergic cells can be divided in different groups based on their electrophysiological properties, one of the groups showing resemblances of human-specific rosehip cells (Boldog et al., 2018; Field et al., 2021). Taken together, we characterized a previously poorly known GABAergic cell-type group, which plays a crucial role in the local entorhinal cortical microcircuit, and we found an interneuron-type, which can be the non-human equivalent of the rosehip-cells.

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Session II. – 10 minute presentation

Csenge Sólyomvári

## Protective effects of dehydroepiandrosterone on glia cells and the cholinergic sytem in a neurotoxic Alzheimer's disorder mouse model

Csenge Sólyomvári [1 2 3], Szidónia Farkas [1 2] ,Nicolas Capelo-Carrasco [4 5 6] , Dóra Zelena [1 2]

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Introduction: Alzheimer's disorder (AD) is the most common neurodegenerative disease. Pathological protein accumulation in the brain, such as Aβ and pTau, impacts not only neurons (presumably cholinergic cells), but also microglia and astrocytes. This alters their morphology and heightened glial activity. Dehydroepiandrosterone (DHEA) and dehydroepiandrosterone sulfate (DHEAS) are endogen steroids that are hypothesized to have neuroprotective effects.

Aim: To investigate the protective effects of DHEAS on the cholinergic system and on the microglia and astrocytes.

Methods: We used a neurotoxic AD model induced by Aβ microinjection into the cholinergic nucleus basalis magnocellularis (NBM) region of C57BL6/J male mice. One-hour after the stereotaxic surgery an intraperitoneal treatment with 10 mg/kg DHEAS or vehicle (0.9% saline) was performed. The animals were transcardially perfused 12 days later, and immunohistochemical stainings (ChAT, AChE, Iba-1, GFAP,) were performed to investigate cholinergic cell, microglia and astrocyte morphology, respectively.

Results: The Aβ injection decreased the number of ChAT positive neurons in the NBM and the density of their AChE positive fiber projections in the somatosensory cortex. Furthermore, activated the microglia and astrocytes in the injection site. DHEAS had a protective effect on the cholinergic fibers, decreasing the Aβ induced neurotoxicity. The treatment also decreased the glia cells activation.

Conclusion: Overall, DHEA(S) or similar compounds may provide new insights into understanding the pathology of AD and could represent a new therapeutic target.

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Session II. – 10 minute presentation

Daniel Kimsanaliev

## Age-dependent role of Caskin scaffold proteins in anxiety and repetitive behaviour

Daniel Kimsanaliev [1], András Török [1], Norbert Bencsik [1], Katalin Schlett [1]

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Neuronal scaffold proteins are crucial for organizing signaling pathways involved in plasticity. Caskins, a novel family of less characterized neuronal scaffold proteins, consist of two isoforms: Caskin1 and Caskin2. Caskin1, enriched in postsynaptic regions, interacts with Shank2, the master scaffold protein within the postsynaptic density, while the role of Caskin2 in neurons remains poorly understood. Functional redundancy between these isoforms remains unclear. Previous studies revealed that Caskin1 and Caskin2 double knockout (dKO) mice exhibit spatial learning and memory deficits, while Caskin1 knockout (KO) mice display mild anxiety. However, the behavioural effects of isoform-specific deletions across different ages are not fully explored.

We investigated age-dependent behavioural impacts of Caskin isoform deletions using transgenic mice. Self-grooming and elevated plus maze tests were conducted on Caskin1 KO, Caskin2 KO, and Caskin dKO mice at 2, 4, and 6 months of age, with double heterozygous (dHZ) and wild-type controls.

Our findings show that deletion of both Caskin isoforms significantly reduces grooming behaviour in an age-dependent manner, decreasing total grooming time and the duration of individual grooming bouts. In the elevated plus maze, dKO mice exhibited age-dependently increased anxiety, spending less time in open arms. Similar results were observed in Caskin1 KO mice, while Caskin2 deletion had no significant impact, resembling dHZ and wild-type controls.

These results demonstrate that Caskin isoforms regulate anxiety and repetitive behaviours in an age-dependent, isoform-specific manner, suggesting an important role for Caskin1 in neuropsychiatric disorder mechanisms.

# Session II.

3 minute theses

Session II. – 3 minute thesis

Alistair Todd

## The neurons in the spinocerebellar and pontocerebellar circuits share a common birthday.

Alistair Todd [1]

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The development of the vertebrate hindbrain is controlled by hox genes, which work together to create a precise schedule for the differentiation of neurons. This is essential for the assembly of functional circuits. We hypothesized that neurons born in different regions of the central nervous system at the same time preferentially connect to form functional circuits (same-born-same-circuit theory). Previously, we found that the latest neurons born in the spinal dorsal horn were those that populate the posterior thoracic nucleus (nucleus of Clarke) in lamina VII. We aimed to learn more about the developmental schedule of the neurons that provide inputs to the cerebellum by mapping those neurons born at the same time as the posterior thoracic nucleus. To label neurons born at the same time, we injected a GFP coding DNA expression vector into the fourth ventricle of 12.5-day-old mouse embryos. We transfected the newborn neurons with in utero electroporation technique and allowed the embryos to grow and be born. We then let the mice reach young adult age (P28), and after that, we sacrificed and fixed them by transcranial perfusion with formaldehyde. We dissected their brains with the spinal cord and selected them based on successful GFP labeling. We made serial sections of the hindbrain regions, and the GFP signal was enhanced with immunohistochemistry. The histochemical reaction was visualized with diaminobenzidine, and the sections were mounted on histological slides. In the spinal cord, we found dense labeling in the Clarke's nucleus, as well as in the superficial spinal dorsal horn. However, we did not find labeled cerebellar granule cells, but we did find dense labeling of the cerebellar glomeruli. We only found scattered labeling among the Purkinje cells, and we also labeled Golgi cells in some cases. Our results support our same-born-same-circuit theory but remain controversial due to the methods utilized.

Session II. – 3 minute thesis

Márton Huszár-Kis

## Improving real-time epileptic seizure detection using light-weight deeplearning

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Many nervous system diseases are characterized by oscillatory disturbances at the neural network level. In the case of refractory epilepsy, a new therapeutic approach is the application of transcranial electrical stimulation (TES) during the early phases of seizures to disrupt their propagation. Although previous research from our group has demonstrated the potential of closed-loop TES, its success hinges on the real-time detection of abnormal neural activity. Accurate seizure detection presents a difficult challenge, as neural patterns characterizing seizures are highly variable across patients, the surface EEG data has low SNR ratio and is strongly imbalanced (seizure vs. background). Furthermore, implementing closed-loop stimulation requires the development of a computationally efficient model capable of running in real-time on a low-power device.

In this study, we adopt a solution based on Convolutional Neural Networks (CNNs), a SOTA machine learning method for EEG-based seizure classification. The model is designed to extract spatio-temporal features from the EEG relevant for identifying the early stages of epileptic activity. To improve detection performance, we apply transfer learning, which helps exploit features learned from recordings of different patients. We evaluate the proposed method against conventional features-based methods, including the Random Forest Classifier, a standard benchmark for seizure detection, and XGBoost, another ensemble tree algorithm. The models are tested on the publicly available CHB-MIT dataset, the most widely used dataset by the field, and on our clinically recorded subgaleal EEG dataset.

The CNN model outperformed both tree-based models across nearly all clinically relevant event-based metrics. Real-time detection capability was validated by running the model during online streaming of EEG data. Furthermore, the model's compact size and low computational requirements make it suitable for deployment on micro-controllers.

Session II. – 3 minute thesis

Tamara Hajdu

## Gene expression analysis in the parahippocampal cortex of individuals who died by suicide

Tamara Hajdu [1], Dóra Fanni [1 2], Éva Renner [2], Alán Alpár [2 3], Miklós Palkovits [2], Árpád Dobolyi [1 4]

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Suicide is strongly linked to neuropsychiatric disorders and is characterized by disrupted resting-state network connectivity. Dysfunction in the default mode network (DMN), particularly in the parahippocampal cortex (PHC), is associated with suicidal ideation. The PHC, part of the DMN's ventral hub, mediates communication between resting-state networks and the medial temporal lobe. The PHC plays a role in visuospatial navigation, memory, and mood regulation. Abnormal activation of the PHC has been observed in suicide attempters. Our previous proteomic analysis implicated mitochondrial dysfunction and elevated glutaminolysis in the PHC as key factors in the pathogenesis of suicidal behavior, however, the broader molecular mechanisms remain to be elucidated.

This study investigates the molecular basis of suicidal behavior via RNA sequencing to identify gene expression alterations in the PHC of individuals who died by suicide. Postmortem brain samples from 11 controls and 11 suicide decedents were analyzed using the DeSeq2 pipeline.

A total of 171 downregulated and 201 upregulated genes were identified based on log2 fold change > ±1 and adjusted p-value < 0.05 criteria. STRING protein-protein interaction (PPI) network analysis revealed chemokine gene overexpression associated with neuroinflammation. Gene Ontology (GO) enrichment and Reactome Pathway analysis highlighted oxidative phosphorylation and mitochondrial ATP synthesis as central upregulated processes. GO enrichment and Reactome Pathway analysis suggested that G-protein coupled receptor signaling pathways are pivotal in upregulated genes involved in neurotransmitter signaling and cellular communication. PPI network and GO enrichment analysis of the downregulated genes revealed impaired myelination, leading to disrupted neuronal communication in the PHC of individuals who died by suicide.

These findings indicate gene expression alterations in the PHC may underlie the pathophysiology of suicidal behavior.

Session II. – 3 minute thesis

Kinga Vörös

## Felodipine efficiency analysis on induced neurons derived from Huntington's disease FELL-HD clinical trial patients

Kinga Vörös [1], Apostolopoulos Dimitris [2], Klibi Souha [3], Ágnes Varga [1], Anna A. Abbas [1], Roland Zsoldos [1], Lea Danics [1], Shaline Fazal [2], Csaba Kerepesi [3], Roger A. Barker [2], Karolina Pircs [1 4]

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Huntington's disease (HD) is a neurodegenerative disorder caused by CAG expansions in the huntingtin gene (HTT), causing mutated huntingtin protein (mHTT) aggregation. With onset at 30-40 years, patients typically die within 10-20 years. Autophagy, a lysosomal degradation pathway ensuring cytoplasmic homeostasis, is dysfunctional in HD, contributing to insufficient mHTT protein removal. The Fell-HD trial repurposes Felodipine, a licensed antihypertensive drug, which boosts autophagy, reducing toxic mHTT, neurodegeneration, and symptoms like tremors and motor issues in animal models.

This project, conducted alongside the FELL-HD trial, examines the efficacy of felodipine in induced neurons (iNs) reprogrammed from FELL-HD cohort skin fibroblasts. These iNs retain the genetic and aging signatures of donors, bypassing stem cell or progenitor phases. We converted fibroblasts from the FELL-HD cohort into iNs with similar efficiency and purity. After 28 days, iNs were analyzed for neuronal and autophagy markers using automated microscopy. HD neurons showed reduced neuronal morphology and impaired autophagy at baseline. Felodipine treatments (0.1 µM and 1 µM) for 24 and 72 hours were tested, and huntingtin expression was assessed via qPCR. Based on the results, three groups can be distinguished: a control-like group, an HD-specific and an HD-specific group with increased aging. In the different groups, felodipine showed a different effect, reducing HTT expression in some patients and rescuing both neuronal and autophagic abnormalities. After summarizing the preclinical data, we aim to perform correlation analyses with the clinical results to obtain a comprehensive picture of the efficacy of the drug and the mechanisms influencing it.

As a result, our iN preclinical model can provide predictive information about information about drug effectiveness, opening a new dimension in clinical trial optimization and personalized medicine.

Session II. – 3 minute thesis

Zsófia Balogh-Lantos

# Cell- and layer-specific roles of TRPV1 ion channels in infrared neurostimulation: Insights from High-Density Laminar Recordings in the Mouse Neocortex

Zsófia Balogh-Lantos [1 2], Richárd Fiáth [1 3], Ágoston Csaba Horváth [1], Katalin Kovács-Rozmer [4], Zsuzsanna Helyes [4], Zoltán Fekete [1 5]

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Infrared neurostimulation (INS) has demonstrated the potential to modulate neural activity, with applications in treating neurodegenerative diseases such as epilepsy. Temperature-sensitive ion channels, particularly TRPV1, play a pivotal role in neuronal excitability. However, their role in IR-induced modulation remains unexplored in vivo. This study aims to investigate the involvement of TRPV1 channels in INS using high-density laminar electrode recordings, thereby providing insights into the biophysical mechanisms underlying this approach.

In this study, the effects of INS on cortical neurons in vivo were investigated using high-density laminar recordings. The neocortex of anesthetized TRPV1 knockout (KO) and wild-type mice were exposed to pulsed (500 Hz) and continuous wave (CW) infrared light (1550 nm) using an optical fiber. Over 3000 single units were recorded from 10 mice using a Neuropixels probe. Single units from the cortex were identified as putative principal neurons and inhibitory narrow-waveform and wide-waveform interneurons with suppressed or increased activity, highlighting cell- and layer-specific responses.

The findings revealed that continuous stimulation had a more pronounced impact than pulsed stimulation. In wild-type mice, more neurons were activated than in TRPV1 KO mice. Local field potential analysis revealed a shift in power across frequency bands, with delta and theta powers increasing and alpha and beta powers decreasing during stimulation. Notably, delta and theta powers were higher in KO mice. Additionally, the temporal dynamics during stimulation trials were analyzed. These times were longer in wild-type mice than in KO mice, with pyramidal cells exhibiting the longest run-up times.

These preliminary results indicate that TRPV1 channels have an important role in regulating neural responses to INS. This study offers novel insights into the mechanisms of INS by accurately characterizing layer- and cell-type-specific responses.

# Mini Poster Section

# MINI POSTER-GROUPS OVERVIEW

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- **Áron Orosz:** A new pathway from basal forebrain somatostatin neurons to cortical areas
- **Áron Olivér Kolozsvári:** Medio-lateral H-current gradient in the medial entorhinal cortex
- **Péter Berki:** Distinct thalamo-cortical inputs define subnucleus-specific information processing in the amygdala
- **Barbara Göblyös:** Prokineticin receptors are expressed in GnRH neurons of adult female mice

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- **Anna Virág Bakacsi:** Fast processing of multisensory information between superior colliculus and thalamus
- **Marcell Schmidt:** Age-related changes in dopaminergic areas of the mesencephalon in wild-type and PACAP gene knockout mice
- **Angelika Bodó:** Induction of transient neurocognitive impairment by chemogenetic silencing of subcortical brain areas in rats: implications for potential preclinical disease models
- **Beáta Berta:** Effect of D1-like dopamine receptor antagonist on the hedonic evaluation in the prefrontal cortex
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- **Anna Abbas:** Studying the effect of Cariprazine in induced neurons directly reprogrammed from Huntington's disease's patient's fibroblasts
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- **Szidónia Farkas:** Chronic treatment with estrogen-like compound shows antidepressive and neuroprotective potential in a triple transgenic mouse model of Alzheimer's disorder
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- **Ahmed Mohammed Falih Al-Mnaseer:** Shared molecular pathways between osteoarthritis and Alzheimer's Disease: Insights from bioinformatics analysis.
- **Erika Eliza Kvak:** Investigation of behavioural changes after acute dehydroepiandrosterone treatment for the therapy of Alzheimer's disease in mice
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- **Eszter Geiszelhardt:** Functional characterization of human iPSC neurons of Kleefstra syndrome origin
- **Dorottya Várkonyi:** Thermoregulatory Impairments in Alzheimer's Disease: Comparative Effects of Senktide and Rolipram in 3xTg-AD Male Mice
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- **Dorottya Molitor:** Effects of maternal smoking on retinopathy of prematurity
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- **András Török:** Isoform-specific regulation of behaviour by Caskin neuronal scaffold proteins
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- **Kristóf Furuglyás:** Current Source Density Calculation for Stereo EEG Data
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- **Katalin Zs. Tóth:** Distribution of glial cells around the blood vessels in epileptic human brain tissue
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- **Annamária Benke:** Age- and Disease Dependent Subcortical Neuromodulator Dynamics During a Probabilistic Learning Paradigm
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- **Rafaella Mínea Riszt:** Single versus multi-task measurement of non-human primate short-term memory
- **Barbara Fülöp:** Stress-induced mechanical and thermal pain sensitisation mediated through NLRP3 inflammasome activation
- **Ágoston Csaba Horváth:** Demonstration of the safe operation and long-term use of a custom-designed infrared optrode and headstage system in freely behaving rats

Mini Poster section: group 1.1

Dr. Olga Zagorácz

## Effects of the intrahypothalamic microinjections of neuropeptide QRFP on social memory in rats

Olga Zagorácz [1], Tamás Ollmann [1], László Péczely [1], Kristóf László [1], Beáta Berta [1], Veronika Kállai [1], Erika Kertes [1], Dávid Vörös, Daniella Dusa, Ádám Szábó, László Lénárd [12]

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The emerging role of hypothalamic neuropeptides in social behavior led to increased research interest in the possible involvement of pyroglutamylated arginine-phenylalanine amide peptide (QRFP), a member of the RF-amide family.

Our previous studies suggest a pivotal role of the lateral hypothalamic area (LHA) in the cognitive effects of QRFP, thus LHA was chosen as a target area for treatment. Male Wistar rats received corresponding doses of neuropeptide (200ng or 400ng) dissolved in 0.4 µl saline. The effect of intraparenchymal administration of QRFP on social memory was studied in a Three-chamber paradigm. NPY/NPFF receptor antagonist BIBP3226 was also applied to elucidate the mechanism of possible changes.

Applying QRFP in dose 400 ng directly into the LHA significantly improved social memory. Nevertheless, pretreatment with the NPY/NPFF receptor antagonist, BIBP3226, did not abolish this effect, suggesting that other mechanisms are involved in the observed phenomenon.

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Mini Poster section: group 1.1

Áron Orosz

## A new pathway from basal forebrain somatostatin neurons to cortical areas

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The basal forebrain (BF) is a critical modulator of cortical activity, influencing sleep/wake cycles, motivation, learning, and memory. While cholinergic, glutamatergic, and GABAergic parvalbumin (PV) neurons have been well characterized in their cortical targeting, we report a previously unrecognized long-range GABAergic somatostatin-expressing (SOM) neuronal population in the BF. This population selectively innervates GABAergic interneurons in the dentate gyrus (DG) and retrosplenial cortex (RSC)—regions vital for spatial navigation and contextual memory.

Using SOM-Cre/vGAT-Flp double transgenic mice, viral tract tracing, immunohistochemistry, and confocal microscopy, we show that BF SOM neurons form multiple inhibitory synaptic contacts on PV, SOM, and calretinin-expressing interneurons in the RSC. These synaptic interactions suggest that BF SOM neurons may induce disinhibition of RSC principal neurons, modulating their role in RSC-associated coding. Importantly, fibrephotometry revealed that BF SOM neurons are activated by aversive stimuli, indicating a functional link to state-dependent behavioral responses.

Our findings reveal a novel BF-SOM inhibitory circuit capable of influencing hippocampal and RSC activity through targeted interneuron modulation. This circuit likely plays a pivotal role in adaptive behaviors, such as spatial navigation and memory processing, particularly under aversive or emotionally salient conditions.

Mini Poster section: group 1.1

Áron Olivér Kolozsvári

## Medio-lateral H-current gradient in the medial entorhinal cortex

Áron Olivér Kolozsvári [1], Szilárd Szőcs [1], Klaudia Barabás [1], Nóra Henn-Mike [1], Ágnes Agócs-Laboda [1], Barnabás Rozmán [1], Csaba Varga [1]

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The primary gateway between the hippocampus and cortical regions is the entorhinal cortex (EC), however this area not only convey information via the perforant path, but also processes them through functionally significant cells such as grid cells, border cells, and head-direction cells.

The perforant path originates in the lateral and medial EC (MEC) and terminates in different parts of the dentate gyrus. The dentate projecting stellate cells in the second layer of the medial entorhinal cortex exhibit a distinct sag potential and subthreshold oscillations which is caused by H-currents. Previous studies have shown that, H-current in the dorsal part of the MEC is greater than the ventral part and this phenomenon could underlie the different spacing of grid-cell activity.

In our study, using in vitro patch-clamp technique, we found that the H-current change along not only dorso-ventrally, but also medio-laterally as well within the MEC. We hypothesize that this will also result in grid cell spacing differences in a medio-lateral fashion.

Mini Poster section: group 1.1

Peter Berki

## Distinct thalamo-cortical inputs define subnucleus-specific information processing in the amygdala

Péter Berki [1], Ákos Babiczky [2], Kinga Kocsis [3], Aletta Magyar [1], Sándor Borbély [1], Antal Berényi [4], Ferenc Mátyás [1]

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Emotional regulation is an important higher-order function of the nervous system, which plays a critical role in our daily life. During this process, external multisensory stimuli are integrated with internal (arousal, salience) signals, a mechanism essential for generating fast and adaptive behavioural responses across diverse situations. Importantly, pathological alterations of emotional regulation (e.g., mood disorders, depression, PTSD) impose substantial mental and financial burdens on our society, therefore, elucidating the underlying mechanisms behind these processes is of great importance. The amygdala is a known mediator of fear learning through computing external cues (threat) and internal (arousal-related) signals. However, fine details about these coding mechanisms remains unclear3. While there is a widely known model which posits serial information processing of these signals from cortical and thalamic regions to cortical-like amygdala subnuclei (lateral and basolateral), generating an output in the central nuclei of the amygdala, evidence supporting this view is inconsistent. Recently gathered data indicate that different amygdala subnuclei receive inputs from distinct cortical and thalamic regions in a largely non-overlapping manner and strongly suggests a more complex, subnucleus-specific parallel mode of processing. In order to reveal the exact information flow within distinct thalamic subnuclei, we carried out complex anatomical tracing experiments combined with human tractography and high-density electrophysiological recordings. We demonstrate that there is a dichotomy in the thalamo-cortico-amygdala network existing both in human and mice, which is composed of several parallel intra-amygdala routes with separate striatal outputs. Therefore, our results challenge the current view of emotional processing in the amygdala and suggests that different aspects of emotional behaviour are mediated by separate amygdala circuits.

Mini Poster section: group 1.1

Barbara Göblyös

## Prokineticin receptors are expressed in GnRH neurons of adult female mice

Barbara Göblyös [1], Imre Kalló [1], Zsolt Liposits [1]

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Prokineticins (PK1, PK2), produced in the brain, exert their effects via G protein-coupled receptors, prokineticin receptor 1 and 2 (PKR1, PKR2). PKs are involved in the central regulation of diverse functions including reproduction. Besides acting as chemoattractant for guiding migration of GnRH neurons during embryonic life, their role seems to be important also in adult, cycling females. Antagonizing prokineticin receptors has been shown to arrest the estrous cycle and blunt the circulating luteinizing hormone (LH) level.

The aim of the current study was to reveal whether GnRH neurons, which form the final output pathway of the neuronal network regulating LH release, are direct targets of prokineticin signaling.

Highly sensitive RNAscope hybridization was employed to detect mRNAs for PKR1 and PKR2 in neurons expressing GnRH mRNAs in 25 µm-thick, vibratome sections. Confocal microscopic analysis of the signals revealed that most of the GnRH neurons were positive for PKR1 transcripts. PKR2 mRNAs were also expressed, at a lower-level, present in one third of the GnRH neurons (32.4 ±1.5%).

Immunohistochemical double labeling confirmed the expression of PKR2 in GnRH neurons indicating that even low levels of mRNA are translated to receptor proteins.

These results suggest that PKs can directly regulate GnRH neurons. Further studies are required to identify the exact source of PK neurons targeting the GnRH system, and the physiological consequences of PK exposure on the release of GnRH.

Mini Poster section: group 1.2

Anna Virág Bakacsi

## Fast processing of multisensory information between superior colliculus and thalamus

Anna Virág Bakacsi [1 2], Anett Futácsi [3], Gergely Szarka [3], Péter Berki [1 2], Aletta Magyar [1 2], Sándor Borbély [1], Kinga Kocsis [4], Béla Völgyi [3], Ferenc Mátyás [1 5]

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In a dynamic, multisensory environment, the brain plays a crucial role in recognizing and integrating relevant stimuli to produce an appropriate behavioral response. Our previous findings suggested that during threat learning, the association between conditioned (CS) and unconditioned stimuli (US) could occur at the level of the LA-projecting calretinin-expressing lateral thalamic (LTCR) cells, that receive strong superior collicular (SC) input (Barsy, Kocsis et al., 2020). SC is a key site for multisensory integration and has recently been implicated in higher cognitive functions, such as fear learning. However, the nature of the signals transferred and the SC-LTCR circuit's role in fear processes remain largely unknown.

To answer these questions, first, we anatomically dissected the SC-LTCR connection and found that not only the glutamatergic, but also the GABAergic collicular cells were able to form synaptic contact with LTCR neurons, sometimes even with the same cell. These cells carry distinct type of information to LTCR, revealed by monosynaptic rabies-mediated retrograde tracing. Then, using optogenetics and electrophysiological approaches we examined the response properties of LT-projecting SC cells to uni- and multimodal (visual, auditory, and somatosensory-pain) stimuli in vGAT-Cre and vGluT2-Cre mice. We found that multisensory signals rather than the single sensory cues were able to alter the activity pattern of both vGluT2+ and vGAT+ collicular cells, which, in turn, modulated the LTCR cells with short latency. These latencies were consistent with the CS-US association window observed in the LT and amygdala. Our ongoing studies aim to clarify the precise electrophysiological properties and impacts of these fast collicular signaling on thalamo-amygdalar communication. In sum, the SC-LTCR-LA circuit mechanism can contribute to the fast and plastic signal integration during affective processes and promote the survival of the animal.

Mini Poster section: group 1.2

Marcell Schmidt

## Age-related changes in dopaminergic areas of the mesencephalon in wild-type and PACAP gene knockout mice

Marcell Schmidt [1], Dániel Pham [1], Balázs Dániel Fülöp [1], Balázs Gaszner [1], Tünde Tóth [1], Dóra Reglődi [1], Andrea Tamás [1]

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The neuroprotective effect of pituitary adenylate cyclase-activating polypeptide (PACAP) has been demonstrated in several Parkinson's disease models, and its absence accelerates aging in PACAP gene knockout (KO) mice. In previous studies, we investigated dopaminergic regions in wild-type and PACAP KO mice up to 8 months of age. In the substantia nigra (SN), we observed no dopaminergic cell loss but noted an increase in microglia, whereas in the ventral tegmental area (VTA), significant dopaminergic cell loss was seen with aging, particularly in KO mice, along with a continuous decrease in microglia until 8 months.

In this study, we compared the SN and VTA regions in 4-month-old and 1.5-year-old wild-type (n=5-5) and PACAP KO (n=8-9) mice. Dopaminergic neurons were labeled with tyrosine hydroxylase (TH) and microglia with Iba1, categorizing their activity based on morphology. Additionally, we assessed the expression of the PACAP-specific PAC1 receptor.

Our results showed a significant age-related reduction in dopaminergic cells in the SN, with notably fewer TH+ cells detected in both regions of 1.5-year-old KO mice compared to wild-type controls. The number of both active and inactive microglia increased significantly in aged KO mice, while in wild-type mice, age-related microglial increases were confined to the VTA. Expression of the PAC1 receptor was minimal in all groups.

The pronounced reduction in dopaminergic cells in older PACAP KO mice suggests increased vulnerability to age-related neurodegenerative processes, similar to those seen in Parkinson's disease. The observed increase in number and activity of microglia in aged KO mice may result from the loss of PACAP's immunosuppressive effects, contributing to dopaminergic cell death. These findings indicate that, in the absence of endogenous PACAP, age-related morphological changes associated with Parkinson's disease advance more rapidly, highlighting PACAP's potential role in the disease's pathomechanism.

Mini Poster section: group 1.2

Angelika Bodó

# Induction of transient neurocognitive impairment by chemogenetic silencing of subcortical brain areas in rats: implications for potential preclinical disease models

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Introduction: Designer Receptors Exclusively Activated by Designer Drugs (DREADD) is a chemogenetic method which is based on inducing the expression of receptors that can be reversibly and exclusively activated or silenced by so-called actuators in our brain area of interest. However, literature about its preclinical use is so far limited.

Aim: We aimed to develop novel translational animal models of neurocognitive disorders, showing their pathological behavioural symptoms. For this purpose, we silenced the nucleus basalis magnocellularis (NBM) and the ventral tegmental area (VTA) using DREADD technology and assessed the induced cognitive disturbances in behavioural pharmacological tests.

Methods: Stereotaxic surgery was used to inject expressional vectors including hM4D(Gi) receptor and mCherry reporter gene into the NBM or VTA of rats (n=5/group). 6 non-operated animals were used as controls. We assessed different parameters: arousal, motivation in rat psychomotor vigilance task (PVT), declarative memory in novel object recognition test (NOR), spatial memory by Morris water maze test (MWM). Animals were treated subcutaneously with 3 different doses of deschloroclozapine (DCZ) or vehiculum at 30 min before the experiments in a within-subject design (PVT, NOR) or with a single high dose of DCZ (MWM).

Results: In the PVT task, the increase in the number of missed trials in NBM group shows decreased motivation, whereas the high number of premature responses in VTA group implies impulsivity. In the NOR test, DCZ treatment impaired declarative memory in NBM group, whereas it was improved in VTA group. In the MWM test, compared to controls, both NBM and VTA animals showed impaired learning curves and spent significantly less time in the target quadrant during probe trial.

Conclusion: We successfully induced brain area-specific cognitive impairments by chemogenetic silencing, that could be further evaluated as potential animal models of human neurocognitive disorders.

Mini Poster section: group 1.2

Beata Berta

## Effect of D1-like dopamine receptor antagonist on the hedonic evaluation in the prefrontal cortex

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Anhedonia refers to the reduced ability to experience pleasure or respond to pleasure in social, physical or eating context. It is a common symptom of many mental illnesses including depression, schizophrenia or eating disorders. Human studies have showed that the severity of anhedonia is related to the dysfunction of the prefrontal cortex (PFC) with a presumed role of dopamine.

In the present study we examined the effect of inhibition of dopamine D1-like receptor in the hedonic evaluation in male Wistar rats. Animals were microinjected with 0.4 µl of 1 µg D1 dopamine receptor antagonist SCH 23390 or vehicle solution into the medial prefrontal cortex (mPFC). Then, taste reactivity test was performed by intraoral infusion of 30 % sucrose solution (0,5 ml) through an implanted oral cannula. Hedonic evaluation was determined by counting of positive (ingestive) and negative (rejective) orofacial responses. The possible involvement of antagonist SCH 23390 on the motor functions was also examined in open field test.

Our results showed that administration of 1 µg dopamine D1-like receptor antagonist into the medial PFC modifies the hedonic value of 30% sucrose solution. 1 µg SCH 23390 reduced the hedonic score of sucrose by decreasing the number of ingestive responses and increasing the number of rejective responses. Microinjection of 1 µg SCH 23390 did not affect the motor activity of the animals in the open field test. We can conclude that inhibition of D1-like dopaminergic receptors in the medial PFC reduce the hedonic value of a highly palatable sweet solution, without affecting the motor system.

Mini Poster section: group 1.2

Melinda E. Gazdik

## Network activity alterations by common antipsychotics in cultures of mouse primary hippocampal neurons

Melinda E. Gazdik [1 2 4], Lea Danics [2 4], Anna A. Abbas [2 4], Balázs Kis [2 4], Kai K. Kummer [3], Katalin Schlett [1], Karri P. Lämsä [4], Attila Szűcs [1 4], Karolina Pircs [2 4 5]

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A wide variety of antipsychotics are used to treat mental disorders, including schizophrenia, bipolar disorder and chronic depression. A common feature of such drugs is a negative effect on dopaminergic signaling. Dopamine, one of the key neurotransmitters and modulators have been shown to regulate the activity of both excitatory and inhibitory neurons, thus reduced dopamine signaling can have a strong effect on network activity of neurons expressing dopamine receptors.

Our present project focuses on a novel antipsychotic drug, cariprazine (CAR), and its effect on neural function. We decided to investigate chronic functional effects of CAR in a well described model system of cultured mouse primary hippocampal neurons. Long-term recordings were performed using the high-throughput recording capabilities of the Axion Maestro system allowing the simultaneous monitoring of neuronal networks in 24 independent wells, each containing 16 electrodes. Cariprazine (0.1 and 1 µM) was applied either chronically (48-hour) or in acute conditions. Additionally, to compare the effectiveness of the drug, we used three more compounds – aripiprazole, haloperidol, pramiprexole – and applied them acutely.

Chronic CAR administration improved network synchronization and regularity of bursts generated by the neurons. More pronounced effects were observed upon acute application of increased concentration of the drug, namely, firing rate in all wells were markedly reduced with improved synchronization among the neurons. In contrast with CAR, haloperidol and aripiprazole completely eliminated firing in all treated cultures, pramipexole displaying similar, although less dramatic reduction of activity.

Our experiments have shown that compounds that mainly act on D2 receptors (haloperidol and aripiprazole) have a strong effect on neuronal activity, while drugs that prefer D3 receptors (cariprazine and pramiprexole) are moderately able to alter hippocampal network activity in vitro.

Mini Poster section: group 1.2

Zsoldos Tamás

## Selectivity and function of the median raphe in the hippocampus

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The median raphe region (MRR) is an important mood regulatory centre of the brainstem. However, the function of the MRR vesicular glutamate transporter 3 (vGluT3) positive cells is poorly understood. Since their activity is enhanced by negative experiences, we hypothesized that their projection pathways contribute to the processing of negative experiences. In this work, we aim to map these pathways and understand their functions. We have mapped the target-selective connections of MRR vGluT3 neurons using adeno-associated viral fluorescent pathway tracing. Histological processing was complemented by immunohistochemical techniques. Our results show that MRR vGluT3 neurons innervate heterogeneous interneuron populations in the stratum lacunosum of the cornu ammonis regions of the hippocampus and in the hilus of the gyrus dentatus, including calbindin-, calretinin- neuronal nitric oxide synthase- and vGluT3-positive interneurons. In addition, we identified projection pathways to the basolateral amygdala and motor, anterior cingulate and prelimbic cortices. Our understanding of these anatomical connections now provides the opportunity to design and evaluate behavioural studies using stimulatory or inhibitory optogenetics. Our results will contribute to our understanding of the role of brainstem networks in processing negative experiences, which may also help to identify potential therapeutic targets.

Mini Poster section: group 2.1

Koppány Párdi

## The histone deacetylase inhibitor SAHA protects the blood-brain barrier against ischemic injury

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During an ischemic event, blood flow interruption and the subsequent oxygen-glucose deprivation (OGD) cause blood-brain barrier (BBB) disruption and neuronal death, which may have life-threatening consequences. Protection of the BBB as a therapeutic target is a novel concept in medicinal strategies to treat ischemia-reperfusion injury. Our aim was to investigate the possible protective effect of a clinically used histone deacetylase inhibitor, suberoylanilide hidroxamic acid (SAHA), against BBB disruption in the cell culture model of ischemic stroke.

We cultured human brain endothelial cells and brain pericytes under three different conditions: normoxia, OGD, and reoxygenation after OGD (OGD/R) and then tested the effect of SAHA on BBB dysfunctions. SAHA promoted BBB protection against OGD/R by enhancing several barrier functions: it increased transendothelial electrical resistance (TEER), decreased the permeability of trans- and paracellular tracers, increased the protein level of the important tight junction protein claudin-5 measured by immunofluorescent intensity, and also increased the intensity of the glycocalyx constituent syalic acid. We also observed that SAHA had barrier-strengthening effects only in the presence of brain pericytes, suggesting that pericytes have a pivotal role in the protective mechanism of SAHA.

Our results suggest that SAHA has beneficial effects on the integrity of the BBB after OGD and may prove useful as a therapeutic drug in the treatment of ischemia-reperfusion injury.

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Mini Poster section: group 2.1

Anna Anoir Abbas

## Studying the effect of Cariprazine in induced neurons directly reprogrammed from Huntington's disease's patient's fibroblasts

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Huntington's disease (HD) is an uncurable autosomal dominant progressive neurodegenerative disorder. The role of the dopaminergic system in the development of HD symptoms is crucial, as the central dopaminergic pathways are overactivated in HD. The dopaminergic overactivity can be reduced by several drugs. However, their effectivity on psychiatric symptoms is limited. Moreover, the treatment of apathy and cognitive symptoms still remains challenging in HD. Cariprazine, a third-generation antipsychotic is acting as a dopamine D3 and D2 receptor agonist. Previous results shown positive effect in HD patients after cariprazine treatment. Clinical studies indicated positive effects in early-stage HD patients after cariprazine treatment in some psychiatric symptoms such as depressed mood, apathy and cognitive function in patients. Moreover, cariprazine also improved dopamine imbalance in the prefrontal cortex.

Aims: In this project, we aim to study the effect of cariprazine in a novel in vitro model system of HD using donor-derived aged-induced neurons. Our goal is to understand the putative beneficial effects of cariprazine in HD patients and to better understand its mechanism of action by focusing on autophagy. Using reverse translational strategy, we use cariprazine treatment in induced neurons directly reprogrammed from ctrl, HD drug-naive and cariprazine-treated HD patients' fibroblasts. For detection, we use immunocytochemistry (ICC) followed by high-content automated microscopy (HCS). We suppose that the described abnormal neurite morphology and the neurite-specific impairment of subcellular autophagy are positively altered following cariprazine treatment.

Mini Poster section: group 2.1

Lina Li

# The potential protective effect of PACAP on the vertical signal transduction pathway in type 2 diabetic retinopathy

Li Lina [1], Diana Denes [1], Andras Varga [1], Evelin Patko [1], Dorottya Molitor [1], Edina Szabo [1], Balazs Meresz [1], Dora Reglodi [1], Alexandra Vaczy [1], Tamas Atlasz [1 2]

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Introduction:

Diabetic retinopathy (DR) is the leading cause of vision impairment and permanent blindness in one-third of the working-age diabetic population. Our previous research has shown that the pituitary adenylate cyclase-activating polypeptide38 (PACAP38) has potent retinoprotective effects. The aim of the present study was to investigate the protective effect of PACAP focusing on the vertical information processing pathway in type 2 diabetic retinopathy (T2DR).

Methods:

Three-month-old male Wistar rats were divided into control and diabetes groups. To induce T2DR, animals were injected with streptozotocine (STZ) (i.p. 30mg/kg) and were maintained on a high-fat diet. Systane (vehicle) and PACAP38 eye drops were administered twice a day to the experimental groups, accordingly (Control+Systane, Control+PACAP, Diabetes+Systane, Diabetes+PACAP). After 6 months of diabetes duration, rats were sacrificed, and their eyes were collected for further immunohistochemical and western blot analysis.

Results:

Our immunohistochemistry results confirmed the severe damage in the vertical signal transduction pathway in diabetic retinas, evidenced by the breakage of the outer and inner blood-retinal-barriers (BRB), the serious destruction of photoreceptor cells, the decreased rod bipolar cells and ganglion cells. Western blot analysis confirmed the significant reduction of ZO-1 expression. However, PACAP38 treatment moderated the damage to all three-order neurons, their morphological appearance, and the density of these cells.

Conclusion:

Our results have been disclosed that PACAP38 has a potent neuroprotective effect in type 2 diabetic retinopathy, therefore PACAP38 can be a potential therapeutical candidate against T2DR.

Mini Poster section: group 2.1

Ali Fakhrudin Dadawalla

## Investigating Astrocytic Autophagy During Aging Using Directly Reprogrammed Human-Induced Astrocytes

Anna Anoir Abbas [1], Ali Fakhrudin Dadawalla [1], Julie Bouquety [2], Janelle Drouin-Ouellet [2], Karolina Pircs [1 3]

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A dramatic increase is eminent in global population aging by the end of the century, which consequently, will result in high incidences of currently uncurable neurodegenerative diseases, like Alzheimer's and Parkinson's disease. Therefore, there is a need for better modeling and understanding physiological and pathological aging processes of the brain. Impairment in astrocytic autophagy – a lysosomal degradation pathway – is associated with physiological aging, however, the exact mechanism that elicits this dysfunction remains unclear. The aim of this project is to determine the effects of autophagy in aging using directly reprogrammed astrocytes obtained from human dermal fibroblasts (HDFs). This technique ensures that we can obtain functional induced astrocytes (iAs) containing donor's genetic and epigenetic aging signatures. We will analyze five young and five old donor-derived iAs and conduct comprehensive molecular and biochemical studies to further elucidate a conclusion about autophagy impairment and its role in aging. iA markers will be initially analyzed via immunocytochemistry followed by high content automated microscopy. Additional analyses will include measurement of astrocytic gene expression using qPCR, DNA methylation array, proteomics, and electrophysiological activity via patch-clamp recordings. Once functionality has been assessed, we will measure and compare autophagy in our young and old iAs. Preliminary findings indicate successful direct conversion of HDFs to iAs and effective characterization of several known functional astrocytic properties. Ultimately, our findings will provide novel insights in astrocytic aging, and thus pave a trail towards novel therapeutic targets that promote neural rejuvenation and healthy brain aging.

Mini Poster section: group 2.1

Balazs Meresz

## PAC1 Receptor Activation by a PACAP Fragment Alleviates Anterior Segment Inflammation in Endophthalmitis

Balazs Meresz [1], Denisa Fogelova [1], Inez Bosnyak [1], Dorottya Molitor [1], Bela Kocsis [3], Dora Reglodi [1], Tamas Atlasz [1 2], Alexandra Vaczy [1]

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Introduction: Endophthalmitis is a serious intraocular inflammatory disorder resulting from infection and may lead to irreversible blindness. Due to the rapid progression of the disease early detection and appropriate treatment application are crucial to preserving vision. The potential therapeutic effects of pituitary adenylate cyclase activating polypeptide (PACAP) have already been investigated in multiple eye diseases. Our research group discovered that the activation of the PAC1 receptor can reduce the extent of inflammation in case of bacterial keratitis. A short PACAP fragment has been identified, that exclusively stimulates the PAC1 receptor and able to penetrate through the cornea via eyedrops. Our aim was to investigate the anti-inflammatory effects of PACAP fragment in a mouse model of endophthalmitis, focusing on the anterior segment of the eye.

Methods: Systemic inflammation was induced in CD1-IGS mouse strain via intraperitoneal injection of lipopolysaccharide (LPS). The animals were treated 6 times within 24 hours with eye drops containing PACAP fragment. At the peak of the inflammation, non-invasive optical coherence tomography (OCT) was used to obtain high-resolution cross sectional images of the anterior segment of the eye. To assess morphological changes OCT images were analysed by ImageJ and Matlab programs.

Results: OCT image analysis revealed cornea swelling, evidenced by increased central corneal thickness. Due to the inflammation enhanced corneal reflectivity with increased mean pixel intensity of the epithelial and stromal layer were observed. Anterior cell infiltration was detected in the anterior segment of the eye. PACAP fragment treatment reduced the severity of inflammation, as indicated by mild OCT findings: reduced corneal thickness and lower corneal reflectivity.

Conclusion: The PACAP fragment exhibited anti-inflammatory effects via PAC1 receptor activation, highlighting its potential as a therapeutic approach for endophthalmitis.

Mini Poster section: group 2.2

Szidónia Farkas

## Chronic treatment with estrogen-like compound shows antidepressive and neuroprotective potential in a triple transgenic mouse model of Alzheimer's disorder

Szidónia Farkas [1 2 3], Adrienn Szabó [2 3], István Ábrahám [1 2], Tamás Kovács [1 2], Dóra Zelena [1 2 3]

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Background: Alzheimer's disease is the most common type of cognitive dementia, affecting elderly women 1.6–3x more than men or younger individuals. The advanced progression can be due to decreased hormone synthesis in post-menopause. 17β-estradiol (E2) is well-known for its neuroprotective effects. However, due to the risk of serious side effects, using a modified version of the compound is essential. Activators of non-genomic estrogen-like signalling (ANGELS) could be promising.

Aim: Based upon our previous experiments we aimed to examine the neuroprotective effects of a chronic treatment with an ANGELS molecule in a triple-transgenic mouse model of Alzheimer's disease (3xTg-AD).

Material and methods: The experiment was performed on 6-month-old genetically modified female 3xTg-AD mice, and their control strains. Animals received a chronic (2 month) daily s.c. treatment of vehicle and 33ng/g ANGELS compound (A2). During treatment behavioral tests were performed: Y-maze, open field (OF), novel object recognition (NOR), social discrimination (SD), Morris water maze (MWM) and forced swim test (FST). The Aβ1-42 plaques, Tau aggregates, choline acetyltransferase (ChAT) cell number, and acetylcholinesterase (AChE) fiber density in the brain were determined with immunohistochemistry.

Results: AD animals show bad working memory, tend to be more anxious and move less than control strains. The ANGELS treatment did not affect working (Y-maze) and spatial memory (MWM), nonetheless, significantly improved object memory. The tested ANGELS had antidepressive effects in FST. The treatment increased the AChE positive fiber density in the somatosensory cortex, without influencing ChAT cell numbers in the basal forebrain.

Conclusion: The tested ANGELS had antidepressive effects and improved object memory after chronic treatment. Moreover, they proved to be protective in morphological examinations. We believe that these or similar compounds may provide a novel approach in AD therapy.

Mini Poster section: group 2.2

Éva Zsuzsanna Nagy

## The effects of miR-137 and miR-219 overexpression in a Drosophila model of Alzheimer's disease

Éva Zsuzsanna Nagy [1], László Bodai [1]

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Alzheimer's disease (AD) is an incurable neurodegenerative disease that is known as the leading cause of dementia. With the progression of the disease, both its symptoms and its cellular and molecular pathology get more severe. One of the molecular pathological alterations in AD is the dysregulation of microRNAs, which are short, non-coding RNA molecules with a role in translational regulation. In neuronal tissues of AD patients, the level of several microRNAs differs from that measured in control patients, which might to lead changes in the amount of protein factors. miR-137 and miR-219 are conserved microRNAs that have important roles in neural metabolic pathways and are implicated in the pathology of neurodegenerative diseases, including Huntington's disease and AD. In this study, we focused on the effects of the two aforementioned microRNAs in amyloid-beta-induced pathology in a Drosophila AD model. We investigated the effects of manipulating the levels of miR-137 and miR-219 in Drosophila overexpressing amyloid-beta transgenes in the nervous system, and also in wild-type flies. We studied the consequences of miRNA dysregulation using three different methods that allow the analysis of the effects exerted on the scale of neurodegeneration, motor activity, and the toxicity of the microRNAs. After determining the impact of the two microRNAs, we measured the expression of the amyloid beta-transgene gene, which is responsible for the neurodegeneration in our models. The results help us to understand the underlying molecular causes and pathological pathways that contribute to AD pathology, and also expand our knowledge about the function of the investigated microRNAs. This work was supported by NKFIH grant OTKA 145898.

Mini Poster section: group 2.2

Ahmed Mohammed Falih Al-Mnaseer

# Shared molecular pathways between osteoarthritis and Alzheimer's Disease: Insights from bioinformatics analysis.

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Background: Osteoarthritis (OA) and Alzheimer's disease (AD) are two of the most prevalent age-associated conditions, both of which have a substantial impact on individuals' quality of life and place a significant burden on healthcare systems worldwide. OA is primarily characterized by chronic joint pain and the progressive degradation of articular cartilage, while AD is marked by gradual cognitive decline and neurodegeneration. Traditionally, these disorders have been regarded as distinct entities, with seemingly unrelated pathophysiological mechanisms. However, emerging research indicates a possible connection between them through overlapping molecular mechanisms. Methods: A comprehensive analysis was conducted using bioinformatics techniques to explore gene expression profiles from the Gene Expression Omnibus (GEO) database, encompassing datasets from OA and AD patients, as well as healthy controls. Differentially expressed genes (DEGs) were identified by employing stringent statistical thresholds, followed by functional enrichment analysis using the Kyoto Encyclopedia of Genes and Genomes (KEGG) to pinpoint key biological pathways. To further elucidate the molecular mechanisms shared between OA and AD, an interactome analysis was performed using the STRING database, highlighting significant protein-protein interaction networks. Results: Key signaling cascades, particularly those linked to inflammasome activation, were identified as critical nodes of convergence between OA and AD. The interactome analysis revealed protein-protein interaction networks that demonstrated molecular overlap between the two diseases, suggesting potential shared pathophysiological mechanisms. These findings underscore the significance of inflammasome activation and its potential role in bridging OA and AD pathogenesis. Conclusion: Our findings underscore the significance of inflammasome activation, and may provide novel therapeutic targets for the integrated treatment of both diseases.

Mini Poster section: group 2.2

Erika Eliza Kvak

# Investigation of behavioural changes after acute dehydroepiandrosterone treatment for the therapy of Alzheimer's disease in mice

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Alzheimer's disease (AD) is a neurodegenerative disorder, and the most typical cause of dementia. Anxiety and depression are fairly common and well-modellable symptoms in AD, severity of which is depending on the progression of the disease. Dehydroepiandrosterone and its water soluble form, dehydroepiandrosterone-sulphate (DHEAS) are endogenous hormones, which might have a positive effect on depressive behaviour, anxiety, and cognitive impairment. Thus, our goal was to evaluate the behavioural changes of acute treatment in a model of AD.

Seven months old male 3xTg-AD (B6;129-Tg(APPSwe,tauP301L)1Lfa Psen1tm1Mpm/Mmjax) and +/+ mice were treated intraperitoneally with DHEAS or saline (10mg\10mL/kg). Previously we observed that acute DHEAS treatment, given 30 minutes before tests had no behavioural effect but diminished morphological alteration 48h later. Thus, this time a later timepoint (24h) was chosen for behavioural examination. To test learning and memory Y-maze (working memory) and conditioned fear tests (CFT) were used. In the later fear extinction was also followed with conditioned stimuli (80dB sound).

In Y-maze test the typical genotype difference was observable (3xTg-AD mice moving less, $p<0.001$) as a possible sign of anxiety). Additionally, CFT also confirmed the increased anxiety of 3xTg-AD mice, with more time spent in immobile posture than the +/+ counter pairs. The extinction was observable in all four studied groups. However, no treatment-induced change was found. The morphological examination showed genotypical alterations.

All in all, we could not confirm that 3xTg-AD mice are more anxious, as a possible early sign. So far, no significant behavioural effect was found with the DHEAS treatment. We can assume that other dose or timing would be required for such changes.

Mini Poster section: group 2.2

Prabhat Kumar

# The influence of antibiotic cocktails on posttraumatic stress disorder like behaviour in male mice

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Posttraumatic stress disorder (PTSD) is a debilitating condition that affects 8%-13% of the general population and 20%-30% of military personnel.Most available treatments rely on psychotherapy and pharmacotherapy, but alternatives are required due to high number of treatment resistance. The gut-brain axis may play an important role in modulating the stress response and emotional regulation thus, gut might be a new therapeutic target.

We aimed to test the hypothesis that drinking antibiotic (AB) cocktail can affect PTSD-like symptoms.

Male CD1 mice was used and AB cocktail was given to the drinking water for 28 days before trauma. We used electric foot shock as trauma and in a conditioned fear paradigm concentrated on freezing as major outcome. As a first step, in an open field test we tested whether the AB treatment influence locomotion as well as anxiety. Traumatized animals were compared to controls, who were put into shock chamber without trauma and in both groups AB treated and control mice were also compared. Twenty-four hours as well as fourteen days after trauma we put the animals back to trauma environment to study acute stress disorder-like as well as PTSD-like behaviour.

Initially AB cocktail was unpleasant, the animals drop weight, but than they used to it and their condition normalized. There was no major impact of the chronic AB treatment on locomotion and anxiety, thus, the results of the PTSD-like behaviour are reliable. The traumatized mice spent significantly more time freezing and jumped also more than non-traumatized animals. Previous AB treatment influenced both the acute stress reaction measured 24h after trauma as well as PTSD-like behaviour measured 14 days after electric foot shock.

Our findings could offer new insights on how ABs influence trauma- and anxiety-related behaviours in neuropsychiatric conditions. We added further knowledge to the brain-gut axes confirming the role of microbiome in our behaviour.

Mini Poster section: group 2.3

Eszter Geiszelhardt

## Functional characterization of human iPSC neurons of Kleefstra syndrome origin

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Kleefstra syndrome (KS) is a neurodevelopmental disorder associated with autism spectrum disorder (ASD), intellectual disability and hypotonia. The syndrome is caused by mutations in the EHMT1 gene, which plays a crucial role in the heterochromatin formation, thus in gene expression. Synaptic plasticity, synaptic scaling, learning and memory formation is severely affected in KS, however, the impact of the functional loss of EHMT1 on the development of neuronal networks in humans remains unclear.

In this study, we modelled neuronal maturation and network formation of human iPSC derived neurons from neurotypical (NT) and young Kleefstra syndrome (KS) patients under in vitro conditions. To study synaptic connections between NT- and KS-derived cultures, voltage clamp measurements were performed weekly for 9 weeks. KS-derived neurons showed spontaneous excitatory postsynaptic currents (sEPSC) from week 1 of development, whereas in NT-derived cultures these appeared only from week 3.

For further investigation of the developing neural networks, Ca-imaging technique was applied during the first four weeks of development. KS cultures demonstrated elevated network activity from the outset, in contrast, the NT cultures showed an increase in activity, reaching a comparable level to the KS cultures by the fourth week of development. Multielectrode array (MEA) measurements were also conducted during the initial six weeks. In the KS arrays, we observed a significant rise in network activity from the first week of induction, as evidenced by an elevated number of firing electrodes and the emergence of burst oscillations. It is noteworthy that the activity in the KS cultures exhibited a decline towards the conclusion of the observation period.

Our findings indicate that Kleefstra syndrome exerts an influence on the network formation properties. In KS cultures, we detected accelerated network activity, which may contribute to the abnormal neuronal network formation observed in ASD.

Mini Poster section: group 2.3

Dorottya Várkonyi

# Thermoregulatory Impairments in Alzheimer's Disease: Comparative Effects of Senktide and Rolipram in 3xTg-AD Male Mice

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Emerging evidence highlights a critical link between thermoregulation and metabolism, both of which are often disrupted in Alzheimer's Disease (AD). Disturbed thermoregulation, influenced by metabolic dysfunction, may exacerbate AD progression. However, the mechanism is not fully understood but can be studied in the popular triple transgenic AD mice (3xTg-AD).

We investigated core body temperature (Tc) changes in 6-month-old male 3xTg-AD mice after hypothermic provocation by senktide (NK3 receptor) substance used for modelling menopausal hot flushes. To test whether the changes are due to vasodilatation or some more specific NK3 effect, another vasodilatory agent, the rolipram (PDE4 inhibitor) was also used.

Tc was continuously monitored using a telemetry system. Mice were subjected to treatments (intraperitoneally) with senktide (0.5 mg/kg), rolipram (1mg/kg), or a vehicle (2% DMSO in saline 0.9% - 10mL/kg) control.

Senktide significantly decreased Tc in WT, but not in KO animals, consistent with its role as an NK3 receptor agonist that modulates central thermoregulatory pathways and vasodilation. It seems to have a specific effect, as rolipram had no effect on Tc and there was no genotype difference after its administration, either.

Our results suggest that neuroinflammation, amyloid plaque deposition, and tau pathology in the thermoregulatory center (probably in the medial preoptic area) may disrupt the NK3 signaling and its downstream effects. Next, we will examine the molecular details of this disrupted thermoregulation using immunohistochemistry and PCR both in the brain and in the brown adipose tissue.

Mini Poster section: group 2.3

András Buzás-Kaizler

## Long-term Microglial Activation Underlying Neuropsychiatric Disorders Following Neonatal Neuroinflammation

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Perinatal asphyxia (PA) and intrauterine systemic inflammation contribute to the development of various neurodevelopmental disorders. Their coexistence significantly worsens clinical outcomes, potentially due to a shared inflammatory pathway regulated by resident brain immune cells (microglia), which can affect higher-order brain network function in the long term. However, the exact neurobiological interactions between the insults remain unclear, hindering the development of specific treatments.

We aimed to investigate the long-term effects of PA, both alone and in interaction with prior inflammation, on microglial populations in male and female mice, focusing on brain regions most relevant to our comprehensive behavioral analysis.

Mice were treated with IL-1β cytokine s.c. on postnatal days 2-6, then a subset was subjected to PA insult on day 7 using a specialized gas mixture (4% O2, 10% CO2). After extensive behavioral testing, including assessments of cognitive and emotional functions, the brains of the animals were fixed through transcardial perfusion, and microglial cells were labeled using immunohistochemistry. Coronal brain sections captured with a SlideScanner were aligned with a mouse brain atlas in multiple steps and labeled cells were quantified across over 300 regions.

Our results showed that PA treatment alone caused a significant long-term increase in microglial density in brain regions associated with cognition and memory (e.g. corpus mammillare, mediodorsal thalamus) and emotional regulation (e.g. basolateral amygdala), which was further enhanced when combined with prior inflammation. These findings correspond with the behavioral changes we observed earlier (learning and attention deficits, increased anxiety).

In conclusion, the systemic inflammation induced by IL-1β enhances the nervous system's vulnerability to PA, worsens the outcome, and leads to more pronounced long-term microglial activation in brain regions responsible for behavioral changes.

Mini Poster section: group 2.3

Dorottya Molitor

## Effects of maternal smoking on retinopathy of prematurity

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Introduction: Premature birth is often linked to various disorders that can impact future quality of life. One such condition is retinopathy of prematurity (ROP), a neurovascular disease affecting the retina. Oxygen-induced retinopathy (OIR) is a well-established animal model of ROP, characterized by vascular abnormalities such as vaso-obliteration and neovascularization. Several factors, including maternal smoking during pregnancy, are known to contribute to premature birth. This study aimed to investigate the effects of maternal smoking (MS) on OIR using in vivo imaging and immunohistochemical techniques.

Materials and Methods: A pigmented strain of laboratory mice (C57BL/6) was used in this experiment. During pregnancy, mice were exposed to smoke twice a day for 30 minutes in a specialized chamber. To induce retinopathy, pups were subjected to 75% oxygen (±2%) from postnatal day (PD) 7 to PD12, before returning them to room air. On PD17, under anesthesia, imaging with optical coherence tomography (OCT) was performed to analyze the retinal layers' thickness. Following the animals' decapitation, their eyes were removed and retinal whole-mounts were prepared and immunolabelled with glial fibrillary acidic protein (GFAP) to visualize Müller glial cell stress.

Results: Measurements with OCT showed that in the case of ROP retinas the thinning of the total retinal thickness and several layers (such as inner nuclear and inner plexiform layer) was significant compared to the controls. Glial cell labeling revealed a trend of increased cell stress in the ROP-affected groups, with a further elevation in the ROP+smoking group.

Conclusion: Our results indicated the possibility that maternal smoking has negative effects on OIR. These findings suggest that maternal smoking may exacerbate retinal damage in ROP, thus prevention and screening of this disease can be considered essential in preterm infant care.

Mini Poster section: group 2.3

Inez Bosnyak

## A plant hormone as a potential therapeutic option in the treatment of ischemic retinopathy

Inez Bosnyak [1], Agnes Nagy [1], Edina Szabo [1], Dorottya Molitor [1], Balazs Meresz [1], Lina Li [1], Tamas Atlasz [1 2], Dora Reglodi [1], Alexandra Vaczy [1]

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Retinal ischemia can easily lead to visual impairment. The prevalence of hypoxia-caused eye diseases is increasing, but effective, non-invasive treatment options are not available. Abscisic acid (ABA) is a plant hormone with anti-inflammatory and antioxidant effects. ABA is also present in various mammalian tissues and plays an important role in metabolic processes. Although many protective effects of ABA have been described in ischemic conditions, little is known about its role in the eye. Based on our previous experiments, ABA treatment in the form of intravitreal injection could attenuate the release of pro-apoptotic factors. We therefore aimed to investigate the potential protective role of ABA eye drops in ischemic retinopathy.

Retinal ischemia was induced by permanent unilateral common carotid artery occlusion (UCCAO) in CD1-IGS mice. Half of the animals received ABA eye drops three times a day for two weeks. Optical coherence tomography (OCT) was used for following the changes in retinal thickness. OCT measurements were taken before the surgeries and 7 and 14 days later. Retinas were then isolated, and immunohistochemistry was performed. Retinal ganglion cells were labeled with Brn3a on whole retinal preparations and photoreceptor staining was also performed.

Based on OCT measurements, ischemic retinopathy was successfully developed. As in our previous results, the retinal layers showed different sensitivities to ischemia. The number of retinal ganglion cells was evaluated in the central and peripheral regions. The ganglion cell number decreased significantly after UCCAO ($p=0.04$) in the central region of the retina. However, ABA treatment could moderate the damage. We experienced more severe ganglion cell loss in the peripheral region. The ganglion cell number decreased after UCCAO ($p=0.001$), but ABA eye drops could prevent this damage.

In conclusion, ABA eye drops may represent a new potential therapeutic option for the treatment of ischemic retinopathy.

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Mini Poster section: group 2.3

Tamara Tavaszi

## Inhibitory innervation of posterior cingulate cortical neurons in schizophrenia

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Schizophrenia (SCZ) is a mental disorder affecting approximately 1% of the population. Patients show positive (hallucinations, delusions), negative (withdrawal, lack of motivation, blunted affect) and cognitive (memory impairment, attention deficit) symptoms. Brodmann area 23 (BA23) is part of the posterior cingulate cortex, which contributes to the functioning of the default mode network (DMN). DMN is active during resting state and its dysfunction was linked to negative symptoms of SCZ. Cortical interneurons are highly heterogeneous and regulate the function of other neurons through the neurotransmitter GABA. Based on our previous results, reduced density of basket cell terminals in the motor cortex can be observed in SCZ, however, BA23 has not been studied yet.

We hypothesized that the density of somatic inhibition in BA23 may be altered in SCZ. Our aim was to determine the density of vesicular GABA transporter (vGAT) immunopositive terminals in the III. and V. cortical layer of human BA23 in the right hemisphere.

Somatic inhibitory input of neurons in the III. and V. cortical layers of human right BA23 with a short postmortem period (2-5h) was investigated in control and SCZ subjects (n=5-5). Fluorescent immunohistochemistry was performed on 60 µm thick sections using neuronal marker (NeuN), vGAT, and nuclear marker (DAPI). Analysis was carried out with 60× large images performed by fluorescent confocal microscopy.

No difference was found in neuron density and in perisomatic vGAT terminal density in layer III. in the right BA23 between control and SCZ samples. In layer V. of BA23 somatic inhibitory inputs were significantly decreased in SCZ.

The fewer inhibitory input of BA23 can affect the regulation of cingulate cortex communication with subcortical regions, and the function of DMN, which might contribute to the development of negative symptoms of SCZ. Our future goal is to examine the interhemispheric differences and the cell type-specific terminal patterns.

Mini Poster section: group 3.1

Sándor Bordé

## A multistep analysis workflow for the classification of cortical LFP events.

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Cortical local fields and oscillatory events are usually analyzed by estimating their spectral characteristics, but these approaches have limited ability to extract all the information carried by the signal. Applying dimensionality reduction methods such as principal component analysis can improve classification performance, help discover hidden patterns, and create new features. We aimed to assemble a multi-step analysis workflow that can transform oscillatory LFP activity into a statistical representation. After filtering and downsampling the LFP signal, waveform segments for the events of interest were collected. The data was projected from the original space to the low-dimensional principal component space. After that, a Self-Organizing Map was trained and used to cluster the segments. Finally, a 2D probability distribution (SOM profile) was calculated for related LFP segments using cluster labels. We applied the workflow to cortical slow wave, theta and spindle oscillations recorded from juxtasomal position of pyramidal cells and interneurons in freely moving rodents. The application of the workflow on the juxtacellular LFP events data set recorded near pyramidal cells (n=65), regular spiking (n=42), and fast spiking (n=33) interneurons (n > 34000 down state events) revealed that the down states express a significant difference in their SOM profiles depending on the type of recorded cell. We conclude that juxtacellular LFP convey cell-type specific information. This suggests that field potentials in the network can be highly compartmentalized and can retain identities of cellular units in space and time, even if neuronal populations are in a silent state.

Mini Poster section: group 3.1

Balázs Kis

# Functional and electrophysiological analysis of aging in induced neurons reprogrammed from adult human dermal fibroblasts

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It is challenging to study human specific functional properties during physiological aging in human neurons due to accessibility. Neurons from model species show similarities to human neurons, but the latter display unique electrophysiological characteristics, like distinct input resistance and action potential threshold voltage. We aim to develop a robust system that will enable reliable, high throughput functional characterization of aged human neurons for drug-screening.

We use an inducible lentiviral system which consists of a doxycycline driven transactivator coupled to a transcription factor ASCL1. This enables us a highly efficient way to reprogram human dermal fibroblasts into induced neurons (iNs). During the transdifferentiation, cells do not go through a pluripotency. iNs keep the genetic and epigenetic aging signature of the donors. This makes iNs uniquely adequate to study aging and age-related diseases from a functional perspective.

We started to optimize the transdifferentiation methodology to whole-cell patch-clamp recordings coupled with current-step measurements. We identified 3 subpopulations in iNs after 25 days of conversion: (i) non-differentiated cells with no neuron like membrane potential, (ii) differentiated-passive cells with neuron like membrane potential, and (iii) differentiated cells with rectification of injected current and spikelets. We are currently repeating our recordings to further optimize our system by increasing the cellular density to engage synapse formation and by optogenetic training expressing ChR2-channel rhodopsin in the iNs. After successfully defining the best culturing conditions, we plan to study functional differences in iNs derived from young and old donors. Identifying age-related electrophysiological changes such as ion-channel response, action potential shape, duration, and membrane potential will be an important step to understand healthy and non-healthy aging and give us potential targets for intervention.

Mini Poster section: group 3.1

Bálint Varga

# Causal Networks of Phase-Amplitude Coupling in Fronto-Temporal Interactions During Working Memory

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Working memory (WM) arises from interactions between the prefrontal cortex (PFC) and other associative cortical areas. In WM, these cortical interactions are coordinated by phase-amplitude coupling (PAC) between neuronal populations. However, the causal mechanisms underlying PAC remain unclear. Our study aims to investigate the causal cortical network involved in PAC during fronto-temporal interactions.

High-density electrocorticography (ECoG) recordings were obtained from the PFC and temporal cortex (TE) of two macaque monkeys performing a delayed color recall task, which required them to recall colors associated with grayscale images.

Task-specific oscillatory activity was dynamically modulated in both temporal and prefrontal cortices. Notably, significant PAC emerged within a localized region of the TE during the delay period, specifically between low (delta-theta) and high (beta-gamma) frequency bands. Using frequency-dependent Granger causality, we identified the PAC site in the TE as being causally linked to specific subregions of the PFC during mnemonic processes, particularly in the theta band. Neural decoding further illuminated the functional role of this causal network, revealing how specific cortical regions represented different aspects of the task.

Our findings highlight the critical role of PAC in working memory and demonstrate the PFC's regulatory function in coordinating cortical interactions.

Mini Poster section: group 3.1

Júlia Puskás

## Monitoring early neural development of the mPFC by whole-cell patch clamping in organotypic slice cultures

Júlia Puskás [1], Schlett Katalin [1], Attila Szűcs [1], Dr. Krisztián Tárnok [1], Dr. Petra Varró [1]

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Previous behaviour tests linked with ex vivo field potential experiments focusing on adult life alterations related to imbalance of excitation and inhibition in layer II-III. of the medial prefrontal cortex (mPFC) showed sex-related excitability changes in the valproic acid (VPA) model of autism spectrum disorder (ASD). The mPFC, called also a “social hub”, is one of these possibly affected areas in ASD patients. Many higher order cognitive functions are linked to this area, such as sociability, social memory and attentional processing.

To examine early life changes on the cellular level of the mPFC, organotypic slice cultures have been implemented from 6 days old pups. Slices are maintained and monitored for 3 weeks in artificial environment, where all the developmental and maturational changes can be followed and cellular architecture and connectivity is maintained. By comparing ex vivo acute and in vitro organotypic slice derived data, developmental changes are followed and compared, validating the in vitro maturation of the neurons and the network activity.

Using whole-cell patch-clamping, I have collected cell-individual and network-related phenomenon of the in vitro organotypic model. Active and passive membrane properties of neurons, as individual parameters, demonstrated dynamic neuronal maturation of the slices. By recording miniature synaptic currents, network properties were investigated, as well. The spontaneous network activity exhibited an exceptionally close resemblance to observable activity of acute slices, indicating that the local connections and activity in organotypic slice cultures remain intact and develop during the in vitro culturing.

The results demonstrate that the model is a reliable tool for advancing our understanding of the VPA-induced ASD-related changes that occur during the early developmental stages.

Mini Poster section: group 3.1

Vivien Szendi

## Functional characterisation of the lateral septal calbindin neurons

Vivien Szendi [1], Miklós Márton Takács [1], Ágnes Fanni Seres [1], Máté Egyed [1], Gina Puska [1 2], Szilvia Oláh [1], Júlia Puskás [1], Petra Varró [1], Attila Szűcs [1 3], Árpád Dobolyi [1]

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The ventral subdivision of the lateral septum (LSv) is a forebrain region linked to maternal care, where a high density of calbindin-containing (Cb+) neurons is present, yet the properties, connections and functions of these cells remain unknown. In the present study, patch-clamp electrophysiological recordings were made of calbindin-containing neurons and we revealed that these neurons exhibit regular firing patterns and possess a notably high membrane resistance. To establish the projections of Cb+ LSv neurons, we applied viral-based, cell-type-specific anterograde tracing, and revealed an extensive projection to the medial preoptic area (MPOA), a central region of maternal behaviour regulation. To confirm whether pup-related information is transmitted from the LSv Cb+ neurons, the pup-induced activation of these neurons was described using the c-Fos technique. To elucidate the pathway through which maternal signals reach the Cb+ LSv neurons, a retrograde tracer was injected into the LSv revealing input from the posterior intralaminar thalamus, which expresses the maternally activated parathyroid hormone 2 (PTH2) neuropeptide. Using double labelling, we identified PTH2 receptors on Cb+ LSv neurons, likely activated by PTH2 released from nearby PTH2 terminals, which we also identified around the Cb+ neurons in the LSv. Using electron microscopy, we confirmed a synaptic connection between PTH2+ fibres and maternally activated inhibitory neurons in the LSv. Finally, functional studies using Cb-Cre mice revealed that the inhibition of LSv Cb+ neurons reduced pup-licking behaviour without affecting other maternal behaviours. In conclusion, our findings collectively suggest that activation of inhibitory Cb+ neurons in the LSv is essential for pup-licking behaviour, likely mediated through their projections to MPOA neurons.

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Mini Poster section: group 3.2

Ágnes Szabó

## Changes in low-frequency cortical activity in response to thermal neuromodulation induced by an intracortical infrared light source

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Infrared neuromodulation (INM) is an effective, safe technique for modulating local cerebral temperature, influencing neuronal activity. In this study, we used in vivo measurements with an optical probe to simultaneously stimulate and record electrophysiological signals in anesthetized rats with minimal noise. After a 2-minute baseline, 2 or 4-minute stimulation periods (ON) were followed by 4-minute non-stimulation periods (OFF), repeating five times during each measurement. The experimental device used for INM was an optrode with a sharp tip, which incorporates an embedded waveguide that transmits infrared light into the cortical tissue. Wideband recordings were performed with 12 linearly placed recording sites at a 20 kHz sampling frequency across cortical layers in acute in vivo experiments with 8 rats. The experiments were grouped based on probe depth, with four cases in cortical layer 6 (L6) and four cases in layer 5 (L5).

During signal processing, we observed that ketamine/xylazine-induced slow waves were significantly modulated by continuous-wave infrared stimulation. We specifically examined changes in the frequency range of delta waves (0.5-4 Hz), dividing them into low delta (0.5-2 Hz) and high delta (2-4 Hz) ranges. Results showed that infrared stimulation in L6 led to increased delta power in both the low and high delta in the supragranular (L2/3) layers, and increased low delta power in the infragranular (L5) layers. Conversely, stimulation in L5 reduced low delta power in both layers, with a more pronounced decrease in L2/3. Additionally, multiunit activity-based up/down state detection revealed that stimulation prolonged down-states and shortened up-states. The aim of future studies is to explore the temperature dependency of spectral and temporal properties of slow waves in freely moving, naturally sleeping animals.

Mini Poster section: group 3.2

Domokos Meszéna

# Spatiotemporal backpropagation patterns of human single unit waveforms revealed by intraoperative high-density Neuropixels recordings

Domokos Meszéna [1] [2], Angelique C. Paulk [1], William Munoz [3], Irene Caprara [3], Mohsen Jamali [3], Brian Coughlin [1], Charlie Windolf [4], Erdem Varol [4], Ziv M. Williams [3], Sydney S. Cash [1], István Ulbert [2] [5] [6]

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High-density silicon probes have been widely used in rodent electrophysiology but were virtually absent from human research until recently. Clinical research devices have so far been able to detect single-unit activity (SUA) with a poor spatial resolution (due to large inter-contact distances) or they have been limited to recording only the population-level signals. We pioneered a rare opportunity to test state-of-the-art Neuropixels probes in operation room settings during surgeries. These probes feature hundreds of closely packed contact sites enabling high-resolution sampling. Spatiotemporally resolved morpho-electric properties allow for sophisticated clustering of neural cell types. We focus on a particular spatial feature of cortical neurons called the backpropagating action potential (bAP). Intracellular spikes can propagate backward along the somatodendritic axis. These bAPs have been observed in rodents in vivo with distinct patterns across brain regions, putative cell types, and morphological orientations. Using algorithms and criteria from published rodent literature, we report the first in vivo evidence for human action potential backpropagation from awake and anesthetized human patients. The appearance of human bAP did not depend on the spike amplitude, firing frequency, or spike count, but was correlated with the cell type. Putative cell types were predicted by their peak-to-trough ratio on the channel with the largest amplitude. Our preliminary results on multi-channel bAP patterns have shown consistency with the rodent findings, as we were able to identify canonical regular spiking (RS) putative principal cells expressing reliable bAPs (over 100 µm), as well as fast-spiking (FS) putative interneurons which lack this spatial propagation. These results highlight the importance of high-density sampling in translational human in vivo recordings for disentangling cell types and morphological contributions to the local neocortical microcircuit.

Mini Poster section: group 3.2

Anna Padányi

## GABA-ergic modulation of cortical excitability in awake non-human primates

Anna Padányi [1 2],Balázs Knakker [1],Riszt Rafaella Mínea [1 2], Szuhád Khalil [1], Evelin Kiefer [1], Inkeller Judit [1], Antonietta Vitális-Kovács [1], István Hernádi [1 2 3 4]

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Disruption in the excitatory-inhibitory (E/I) balance of cortical networks is well-characterised in age-related neurocognitive disorders (NCDs). Utilising a well-established a non-invasive transcranial magnetic stimulation (TMS) protocol, similarly applicable in preclinical translational research and human studies, we recorded baseline cortical excitability in awake adult rhesus macaques and assessed basic GABAergic modulation of E/I balance.

Using neuronavigation-guided single pulse TMS over the M1 region, we recorded motor-evoked potentials (MEPs) with surface electromyography. After establishing stable motor thresholds (MT) (n=8, within-subject SD: 2.41%, ICC: 0.821), we recorded MEP recruitment curves at nine stimulation intensities (50-150% of MT) with 8-10 single pulses in a semi-random order. Pharmacological validation was performed by systemic (i.m.) application of diazepam (GABAA PAM, 0.1, 0.3 and 1 mg/kg, n=4) and RS-baclofen (GABAB agonist, 1 and 3 mg/kg, n=5).

The middle and the highest doses of diazepam shifted the recruitment curve to the right (at 10 min post-administration, showing a pronounced decrease in excitability (treatment effect: $F_{3,382}=28.00$, $p<0.001$) with no treatment×stimulation interaction ($F_{3,382}=1.11$, $p=0.344$). RS-baclofen elicited the expected inhibitory shift only in 3 mg/kg dose, both at 2-hr (stimulation×treatment interaction: $F_{8,32}=2.62$, $p=0.025$) and at 4-hr (stimulation×treatment interaction: $F_{6,18}=7.46$, $p<0.0005$).

In summary, both diazepam and RS-baclofen decreased motor cortical excitability as recorded by recruitment curves, with more prominent effect in diazepam. Results indicate that TMS-MEP recruitment curves provide valuable insight into GABAergic modulation of the motor cortex, highlighting differences in the characteristics of the effects between GABAA and GABAB receptor modulation, and enabling system-level evaluation of potential drugs targeting cortical E/I balance for NCD treatment.

Mini Poster section: group 3.2

Péter Földi

## Cortical control of median raphe subpopulations during complex behaviour

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The dynamic interplay between cortical and subcortical regions underlies complex behavioural processes, yet the specific mechanisms governing these interactions remain incompletely understood. The median raphe nucleus (MRN), a key subcortical structure implicated in modulating arousal, emotion, and cognition, is composed of diverse neuronal populations whose distinct contributions to behaviour have yet to be fully delineated. Here, we investigate the electrophysiological dynamics of two functionally distinct neuronal populations within the MRN during complex behavioural tasks. Furthermore, we plan to explore how the prefrontal cortex (PFC), a central hub for executive control, exerts top-down modulation over these MRN populations. This study aims to uncover the coordinated activity between the two MRN subpopulations and the influence of PFC control on their interaction. Here, we present preliminary data acquired by our custom-designed, automatized behavioural apparatus enabling high resolution behavioural tracking combined with high channel count neurophysiological recording, simultaneous tagging of projection-defined MRN neuron groups and closed-loop manipulation. These innovations let us explore behaviour-coupled interactions between the PFC and MRN at unprecedented precision. Acknowledgement: I would like to acknowledge the invaluable guidance and support provided by Viktor Varga and Norbert Hájos throughout the course of this study. Special thanks are also extended to Gergő Nagy for their assistance in teaching and refining probe implantation techniques, which were crucial for the success of this work. This study was supported by: National Research, Development and Innovation (NRDI) Office of Hungary grant K132735 (V.V.), NRDI Office of Hungary within the framework of the Artificial Intelligence National Laboratory Program (RRF-2.3.1-21-2022-00004) to V.V. and of the Translational Neuroscience National Laboratory (RRF2.3.1-21-2022-00011) to V.V. and N.H.

Mini Poster section: group 3.2

Szabrina Gyori

## Investigating the effects of 3.5 GHz 5G electromagnetic field exposure on heart rate and heart rate variability in healthy young adults

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As fifth-generation (5G) mobile telecommunication technology continues to integrate into everyday life, it raises concerns regarding public health. Due to the novelty of 5G deployment and the controversial findings from previous studies, there is a clear need to further investigate this area and understand the potential effects of 5G radiofrequency on human health. This study aimed to investigate the potential health effects of exposure to non-ionizing electromagnetic field (EMF) from 3.5 GHz TDD 5G NR telecommunication technology on the heart and its basic functions. The study included 31 healthy university student volunteers (10 male) ages 19-27 and was conducted in a double-blind sham-controlled randomized crossover design. Electrocardiogram was recorded in both sessions during 3 blocks of exposure period lasting 26 minutes, and 2-2 blocks of pre-exposure and post-exposure periods, each 17 minutes long. Eyes-open and eyes-closed phases from each block were analysed. Data preprocessing in MATLAB using the HEPLAB toolbox within EEGLAB involved manual artifact and ectopic beat detection, semi-automatic R peak detection from the raw ECG signals and the extraction of normal-to-normal (N-N) intervals. Heart rate (HR), and heart rate variability (HRV) indexes, specifically RMSSD (Root Mean Square of Successive N-N Interval Differences), SDNN (Standard Deviation of N-N Intervals) were calculated from the N-N data in the HRVAS (HRV Analysis Software) MATLAB toolbox. The RMSSD and SDNN indexes were selected because they are widely recognized reliable and standardized indicators of autonomic nervous system activity and cardiovascular health. Statistical analysis was conducted in Jamovi using t-tests comparing the sham and real exposure conditions. Preliminary results show no significant differences between sham and real exposure regarding HR, RMSSD or SDNN. In conclusion, there were no detectable physiological effects of 5G EMF exposure on HR and HRV.

Mini Poster section: group 4.1

Réka Kispál

# From simple tasks to complex challenges: exploring implicit learning in mice through an advanced sequential protocol

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The brain employs various learning strategies to adapt to a changing environment, enhancing individual fitness and survival. Implicit sequential learning involves subconsciously acquiring an order, with skills like cycling, playing basketball, or speaking partially resulting from this process. Our research investigates the neural mechanisms behind sequential learning, focusing on key neuromodulators such as dopamine.

Our goal is to develop a model comparable to human studies for cross-species analysis, aiming to understand how neuromodulators encode learning, with potential implications for treating neurodegenerative diseases.

To address this, we trained mice in an advanced sequential learning protocol, where they needed to learn a four-part sequence, while we measured dopamine release by fiber photometry in the ventral striatum. Each trial involves four ports equipped with LEDs, water tubes, and sensors, with water as the reward. During training, all four LEDs are illuminated, and the animals must determine the correct sequence on their own. Each correct response is rewarded. After an incorrect response, one LED turns off, leaving only three illuminated. This process continues, with one LED turning off after each incorrect response, helping the animals learn the correct sequence. Once the sequence is learned, cues are removed, and animals must complete the sequence autonomously.

The results show that animals successfully learned the sequence. Behavioral performance indicated significant learning progress both with and without visuals cues. Photometric data revealed distinct patterns of dopamine release in the ventral striatum in both conditions. Dopamine release was the highest when the animals guessed the correct part during the first attempt.

Animals could learn and execute a specific sequence in the absence of external cues, relying on internal representations with associated changes in dopamine activity reflecting task learning and performance.

Mini Poster section: group 4.1

Zsofia Eckert

## Emotional, molecular and cognitive predictors of comorbid depression and anxiety in a mouse model

Zsofia Eckert [1 3], Diana Pejtsik [1 3], Zoltan K. Varga [1], Olga Wronikowska [2], Mate Toth [1], Mano Aliczki [1], Zsolt Borhegyi [1], Kornel Demeter [1], Eva Mikics [1]

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Depression and anxiety are the most prevalent mental disorders, and they often co-occur with each other, resulting in more severe symptoms and less effective pharmacotherapy. Despite these problems, the neurobiological background of comorbid depression and anxiety (CDA) are not yet understood. By establishing a mouse model with high translational validity, we strived to examine the emotional, cognitive and neurobiological factors underlying CDA. We used the most common anxiety tests to measure harm avoidance, an endophenotype of anxiety disorders. We measured passive coping, a risk factor for major depressive disorder, by exposing mice to the most common coping tests. Based on our previous results, using multiple repetition sampling and averaging outcomes of these tests, we were able to measure stable traits of animals. Since high trait anxiety and passive coping are risk factors for major depressive disorder, we used a depression model, the Learned Helplessness Test (LH), to examine if anxiety and coping traits can predict stress susceptibility. Our model showed two subpopulations: the “resilient” group showing active coping and low trait anxiety, and the “comorbid” population, showing high trait anxiety, passive coping and learned helplessness. By using machine learning predictions, we reduced the protocol to one anxiety, one coping test and the LH, each repeated 3 times. We performed the reduced model with female mice, which yielded similar results. By examining the cognitive factors of the subpopulations via anautomated home-cage system, we found that the comorbid group exhibited cognitive inflexibility and worse spatial learning. Finally, to examine the molecular background of comorbidity, we performed RNAseq of the VHC and MPFC and found that the comorbid group showed differences in mitochondrial, synaptic and extracellular matrix-related RNA expression. In summary, we developed a translational model of CDA, enabling us to examine its molecular background.

Mini Poster section: group 4.1

András Török

# Isoform-specific regulation of behaviour by Caskin neuronal scaffold proteins

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Neurodevelopmental and neuropsychiatric disorders are often linked to dysregulated functions of neuronal scaffold proteins . Postsynaptic scaffold proteins, including Caskin1 and Caskin2, are implicated in these disorders, yet isoform-specific effects of Caskins remain unexplored. Previous studies show that the loss of both Caskin isoforms significantly impairs learning and memory without affecting motor coordination. Additionally, Caskin double knockdown (dKO) alters phosphorylation patterns and activity-dependent trafficking of GluA1-containing AMPA receptor subunits in hippocampal neuronal cultures.

To investigate the isoform-specific roles of Caskins, we examined anxiety-related and repetitive behaviors using the marble burying test in transgenic mice. Caskin1 KO, Caskin2 KO, and dKO mice were assessed at 2, 4, and 6 months, alongside wild-type (C57Bl6J) and double heterozygous (dHZ) controls. Our results suggest a dose-dependent effect of Caskin proteins, as dHZ mice displayed altered behavior compared to wild-type controls. While the activity of Caskin2 KO mice did not differ dHZ controls, Caskin1 KO and dKO mice exhibited significantly increased burying behavior, emphasizing the critical role of Caskin1 in this complex assey..

Furthermore, we performed immunohistochemistry to analyze the subcellular localization of GluA1-containing AMPA receptors in brain sections from Caskin dKO and wild-type mice. Preliminary data revealed increased GluA1 immunoreactivity in the medial prefrontal cortex and amygdala, with enhanced perinuclear accumulation of GluA1 subunits in Caskin dKO neurons.

These findings underscore the pivotal role of the Caskin1 isoform in regulating anxiety and repetitive behaviors, potentially through its involvement in the localization and trafficking of AMPA receptors.

Mini Poster section: group 4.1

Fadel Ward

# Investigating Beta Band and Surface Laplacian For Motor Imagery Brain Computer Interfacing

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We propose the transformation of the raw EEG data into spherical spline Surface Laplacian based multichannel 2-D images in order to be classified using deep neural models. For the challenging Pysionet motor imagery dataset, the power spectral density estimates of the Surface Laplacian filtered Mu [8-13 Hz], Beta [13-30 Hz], and low Gamma [30-45 Hz] bands were applied to generate three channel images using azimuthal projection and Clough-Tocher interpolation. These images formulate the input for the Deep Neural Network model (ResNet, CNN). The study shows significant classification improvement of the proposed signal-to-image transformation with deep neural networks framework compared to the baseline method Support Vector Machine which is widely used in the Brain Computer Interfacing field, and that adding Low Gamma band improved the motor imagery classification accuracy significantly. This work opens the door to a new area in which the advantage of the deep neural networks regarding image classification can be exploited to better understand the EEG related problems.

Mini Poster section: group 4.2

Kristóf Furuglyás

## Current Source Density Calculation for Stereo EEG Data

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The EEG signal originates from the transmembrane Current Source Density (CSD) of active neuronal populations. Source localization techniques aim to determine the spatio-temporal distribution of CSD, providing precise insights into neuronal localization and activity patterns. Existing CSD methods face challenges, especially with the irregular electrode arrangements typical of stereo-EEG (sEEG) measurements. To address these limitations, we present a novel mathematical approach for calculating CSD in non-regular 3D electrode systems, achieving higher precision compared to existing methods.

Traditional CSD techniques assume electrodes are arranged in regular 1D, 2D, or 3D grids, using graph Laplacian approximations based on neighboring electrodes. These methods fail with irregular electrode configurations like sEEG, where unmeasured dimensions are neglected, introducing significant errors. Model-based source localization techniques, including dipole fitting and LORETA, can handle irregular arrangements but rely on assumptions that often mismatch actual source locations. Such mismatches produce inaccuracies, particularly when electrode coverage is limited, as in sEEG, leading to disturbances from sources outside the recorded volume.

Our Laplace-based method overcomes these issues by utilizing all available electrodes, not just neighboring ones, for local CSD calculation. Simulations with known ground truth CSD distributions confirmed our method's superior accuracy over traditional 1D approximations and model-based inverse methods. By reducing errors inherent in existing approaches, our method offers robust and precise CSD estimation.

This enhanced precision holds significant promise for clinical applications, particularly in localizing seizure onset zones for epilepsy surgery, supporting improved surgical planning and patient outcomes.

Mini Poster section: group 4.2

Iffah Syafiqah Suhaili

# The modulation effect of art painting content on saccade-evoked perceptual processes: A high-density EEG Study

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Art perception involves complex neural processes influenced by the elements and content of paintings. Artistic appreciation unfolds in stages, with early perception occurring within a few hundred milliseconds and later contemplative stages emerging after seconds. This study investigates group-level power differences in the early EEG activity during the perception of four painting categories: Faces, Geometry, Townscapes and People. Participants viewed Abstract and Figurative paintings presented in random order for 8 seconds each, followed by a 4-second blank screen for a “like” or “dislike” key-press response and a 1-second cue. Eye movements were tracked using a Tobii Pro Fusion eye-tracker, while brain activity was recorded via a 128-channel Biosemi ActiveTwo EEG system at 2048 Hz. After pre-processing (1 - 40 Hz filtering and down-sampling to 512 Hz), Independent Component Analysis (ICA) was performed to isolate the neural and non-neural sources. One of the ICA components showed distinct saccade-related lambda waves, i.e. transient potential peaks appearing ~100 ms after saccade onsets, which allowed us to identify individual saccades and visual responses in freeviewing settings, and consequently perform single-trial analysis. EEG data were segmented into lambda-peak-centred epochs (-150 ms to 150 ms), resulting in 400–550 epochs per category. Power spectral density in alpha and beta bands was computed using the FieldTrip EEG Toolbox, with relative power differences analyzed between painting categories (e.g. Faces vs. Geometry, Faces vs. Townscapes). The preliminary results indicate different topography of activations, mainly in the alpha band, distinguishing geometry/townscapes and faces/people contents. Lambda peak analysis proves useful without eye-tracking data. The results confirm that painting content modulates early saccade-evoked perceptual processes, advancing understanding of the neural mechanisms underlying art perception.

Mini Poster section: group 4.2

Katalin Zs. Tóth

## Distribution of glial cells around the blood vessels in epileptic human brain tissue

Katalin Zs. Tóth [1], Péter Szocsics [1], Cecília Szekeres-Paraczky [1], Bibiána Török [1], Tamara Tavaszi [1], O. Salamonné Mihályi [2], Loránd Erőss [3], Zsófia Maglóczky [1]

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Epilepsy is a complex neurological disorder characterized by electrical seizures in the brain. Changes in the integrity of the blood-brain barrier (BBB) and the dysfunction of astrocytes and microglial cells are key factors in its development. During epileptogenesis, these cells produce cytokines that influence inflammatory responses, BBB functionality, and seizure formation.

Our study analyses the spatial distribution of astrocytes and microglial cells in cortical brain tissue samples from control individuals and epilepsy patients with drug-resistant focal cortical dysplasia (FCD2b). FCD2b is a severe malformation of lamination and linked to dysmorphic neurons and balloon cells. The analysis focuses on vascular abnormalities in the supragranular (layers II-III) and infragranular (layers IV-VI) parts of the cortex.

Surgically resected, immersion-fixed epileptic tissue was compared to post-mortem, perfusion-fixed control samples. Fluorescent immunohistochemistry was used to label blood vessels, nuclei, astrocytes, and microglia. Confocal microscopy was applied to quantify glial cells along vessel segments, and statistical analysis assessed differences between control and FCD2b samples (significance: $p<0.05$).

In FCD2b samples, microglial density was significantly elevated in the supragranular layers, while astrocyte density showed no change. In contrast, in the infragranular layers, astrocyte density increased significantly, but microglial density remained unaffected.

The increased density of glial cells in epileptic tissues likely contributes to BBB transformation. Microglial activation and astrocytic responses may play important roles in BBB regulation. Differences in the involvement of supragranular and infragranular layers might reflect the distinct roles of cortical and subcortical areas in epileptogenesis. These findings can contribute to understand better of the role of glia in epilepsy and to identify new therapeutic targets

Mini Poster section: group 4.2

Veronika Panna Házi

# Development of a Hardware-Software System for Real-Time Sleep Spindle Detection and Transcranial Focused Ultrasound Stimulation in Rodents

Veronika Panna Házi [1], Tamás Kiss [1]

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Sleep spindles are bursts of oscillatory brain activity during sleep, lasting 0.5–1.5 seconds with a frequency of 11–16 Hz. They play a key role in memory consolidation, and enhancing this process through non-invasive brain stimulation, such as transcranial focused ultrasound stimulation (tFUS), may improve memory and learning. Achieving this requires a robust real-time detection system. However, current systems are tailored for humans, limiting their applicability to animal studies essential for in-depth research. Additionally, few include stimulation capabilities. I tried to address these gaps by developing a software-hardware system for real-time spindle detection in rodents, designed to interface with an ultrasound transducer for neural stimulation.

I began by testing various spindle detection algorithms offline, implementing and optimizing five detectors. Their performance was evaluated against expert-labeled datasets using metrics such as frequency spectra, spindle duration, and inter-spindle intervals. Three detectors demonstrated efficiency comparable to expert performance. Based on simplicity, accuracy, and stability, one detector was adapted for real-time application.

The real-time system was developed using a Raspberry Pi 4, an ADS1115 ADC, and Python. It was tested with synthetic spindles embedded in pre-recorded EEG signals, as well as signals containing real spindles, using an oscilloscope as the signal source. The system demonstrated reliable real-time spindle detection, with a GPIO pin configured to output a control signal to trigger tFUS upon detection.

To enable in vivo experiments, a 3D-printed headgear was designed to securely hold the transducer on rodent skulls. Its stability was validated on a 3D-printed skull model. This integrated solution, combining software, hardware, and mechanical components, facilitates research into memory enhancement via tFUS and advances the study of sleep spindle oscillations in neuroscience.

Mini Poster section: group 4.3

Annamária Benke

# Age- and Disease Dependent Subcortical Neuromodulator Dynamics During a Probabilistic Learning Paradigm

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Neuromodulators like dopamine (DA) and acetylcholine (ACh) are crucial for learning, memory, and behavior, affecting processing, reward learning, and motivation. In neurodegenerative diseases like Alzheimer's and Parkinson's, disruptions of the cholinergic and dopaminergic systems lead to cognitive decline, impaired reward learning, and emotional dysregulation. However, their dynamics during decision-making remain not fully understood.

In our experiment, water-restricted, freely moving young (n=9), old 3xTg AD (n=3) and old control (n=4) mice were expected to choose between left or right ports following a light stimulus, which encoded water reward with different probabilities. The environment's predictability and variability were controlled by the difference in probabilities and block length. Similar probabilities with short blocks were considered volatile, while distant probabilities with long blocks were seen as predictable. Fiber-photometry measurements were performed using DA and ACh biosensors from the ventral striatum (VS) and basolateral amygdala (BLA), respectively.

In young animals, DA encodes reward prediction errors. ACh scales similarly to DA but it is released more prominently during stimulus detection and side choice. Their dynamics during the task were similar in old animals, while AD resulted in significant changes in these neuromodulatory responses. AD animals showed a proportionally larger release of DA in response to unexpected reward, accompanied by a significantly reduced acetylcholine response. Overall, aged control animals showed stronger cholinergic responses than AD ones. These results indicate a cholinergic deficit in AD, highlighting the marked neuromodulatory changes associated with the disease.

The findings lead to the conclusion that both systems show declines in predictive accuracy associated with aging and dementia. This contributes to a better understanding of the neuromodulatory mechanisms underlying cognitive decline in AD.

Mini Poster section: group 4.3

Aletta Mészáros

## Sub-chronic effects of ultrasonic irradiation in vitro

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Transcranial focused ultrasound (tFUS) neuromodulation (NM) is an innovative technology capable of modifying the function of neurons and the nervous system at a fine spatial and temporal scale without the need of surgical intervention, even through the skull. Research suggests that tFUS NM is effective in the treatment of various neurological and psychiatric disorders. The technology is still in the experimental stage and further investigations are required to fully understand its mechanism of action, effectiveness, and safety.

Our long-term goal is to use tFUS NM in preclinical rodent models to modulate the activity of various brain areas. As a first step towards this goal, we investigated the sub-chronic effect of ultrasonic irradiation in an in vitro experiment supported by in silico modelling. We investigated the neurophysiological effects of ultrasound using current clamp measurements in hippocampal cell cultures. For these recordings, the bath contained bicuculline, CNQX, and AP5 to create a synaptically isolated group of cells, and a current step protocol was performed to record evoked membrane potential changes, including action potential generation. While gross changes were not observed following ultrasound treatment, cells exhibited noisier baseline activity as well as a tendency for more excitable membrane. Numerical simulations using a single compartmental Hodgkin-Huxley model showed that an increase of membrane leakage might explain our observations, suggesting that ultrasonic activation modified the fine structure of the cellular membrane.

In further experiments, we are planning to study the activity of a network of interconnected neurons, as well as record electrophysiological signals during ultrasonic stimulation. Our work was supported by the HUNRENTECH Grant number TECH-2024-020 of the Hungarian Research Network.

Mini Poster section: group 4.3

Rafaella Mínea Riszt

# Single versus multi-task measurement of non-human primate short-term memory

Rafaella Mínea Riszt [1 2 4], Balázs Knakker [1 4], Anna Padányi [1 2 4], Judit Inkeller [1 4], Anonietta Vitális-Kovács [1 4], Evelin Kiefer [1 4], István Hernádi [1 2 3 4]

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Human cognitive test batteries involve multiple tasks to achieve multidimensional characterization of cognition or a specific cognitive function. However, in preclinical translational research test batteries are more frequently used as a set of tasks measured and analyzed separately. The present research aims to explore the challenges and opportunities of a systematic multi-task approach with non-human primates.

In a pilot project 3 adult male rhesus macaques were introduced to a day-by-day alternation of 3 different touchscreen tasks covering object memory (delayed matching to sample, DMTS), location memory (self-ordered spatial search, SOSS) and associative object-location memory (paired associates learning, PAL). The animals had been previously trained and tested in these tasks, but only one task was used for an extended period of time. Thus, we asked the following questions: 1) how fast can the animals reach their target performance level in previously trained tasks, 2) whether day-by-day alternation deteriorates performance in contrast to single-task measurement, 3) whether any combination in the order of tasks interferes with performance, 4) whether any convergent error patterns can be observed by analyzing tasks together.

Preliminary results suggest that the more complex the task was, the more time animals needed to reach target level (SOSS ~ 4 days, DMTS ~ 34 days, PAL ~ 69 days) yet, once they reached target, day-by-day alternation did not deteriorate performance. Analyzing the tasks together we also observed similar error patterns: in SOSS and in PAL errors typically occurred at later phases of the choice sequence. As a next step,

within-session multi-task designs will be introduced to probe task switching costs and to establish the adequacy of such design for behavioral pharmacological experiments in a translational setting.

Mini Poster section: group 4.3

Barbara Fülöp

## Stress-induced mechanical and thermal pain sensitisation mediated through NLRP3 inflammasome activation

Barbrara Fülöp [1], Viktória Kormos [1], Katalin Rozmer [1], Ágnes Király [1] Ádám Dénes[5], Nikolett Lénárt[2], Éva Borbély [1], Zsuzsanna Helyes [1 3 4]

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Chronic stress is known to play a role in both the development and the exacerbation of several chronic pain states, for example diseases like fibromyalgia, where drug therapy is not satisfactory. Neuroinflammation and NLRP3 inflammasome-derived interleukine-1 (IL-1) proinflammatory cytokine-release is involved in stress and inflammatory pain. In our preclinical findings, IL-1 KO mice did not develop chronic restraint stress-induced pain. The NLRP3 inflammasome is a multi-protein complex within inflammatory cells, regulating the processing and secretion of IL-1. Here, we investigated the potential analgesic effect of the NLRP3 inflammasome antagonist MCC950 in a mouse model of stress-induced pain.

The animals were subjected to chronic restraint stress (CRS), placed in a well-ventilated, move-restricting tubes for 6 hours daily for 2 weeks. From the beginning of the CRS protocol, MCC950 or vehicle was administered intraperitoneally daily. The mechanical pain threshold, and the cold tolerance of the hind paw was measured weekly.

CRS induced 15-20% mechanical hyperalgesia developed for the second week. MCC950 prevented the formation of mechanical sensitisation of the hind paw compared to the vehicle treatment. 70-80% cold threshold drop developed by the first week of the CRS protocol. In response to stress, cold hyperalgesia was similar in vehicle-, MCC950-treated animals.

Based on our results, NLRP3 inflammasome play a crucial role in the development of chronic stress-induced pain. MCC950 successfully attenuated the mechanical sensitization caused by CRS, further strengthening the potential of NLRP3-IL-1 pathway as a potential drug target for the treatment of stress-induced pain states, like fibromyalgia.

Mini Poster section: group 4.3

Ágoston Csaba Horváth

# Demonstration of the safe operation and long-term use of a custom-designed infrared optrode and headstage system in freely behaving rats

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Infrared neuromodulation (INM) has shown promise in numerous studies in animals. Although the first human trials have already taken place, the journey toward developing a reliable therapeutic INM implant remains challenging, primarily due to the incomplete understanding of the long-term physiological effects of this method. Here, we present the first validation of a custom IR optrode and headstage system for use in freely behaving rodents.

The optrode can be implanted into brain tissue and enables both optically induced neuromodulation and multi-site electrophysiological recording through a single silicon shank. All aspects of the implant are tailored for use in freely moving animals. To address the challenge of signal quality deterioration over time, we developed a custom-designed micro-drive (µD). This interface allows controlled adjustments of the optrode's penetration depth, thus maintaining signal quality and enabling the modular retrieval of the optrode after experimentation. A protective headstage surrounds the µD, providing a barrier against external forces generated by animal behaviour while securely attaching the data cable and optical fibre to the optrode. The system was tested on 2 rats, with the optrode implanted in the somatosensory cortex. Electrophysiological signals were recorded during IR stimulation at a wavelength of 1550 nm. Multi-unit activity was reliably recorded until the 8th day, and local field potential signals (1–200 Hz) with a signal-to-noise ratio (SNR) of approx. 10 (mean ± standard deviation: 9.66 ± 3 and 9.55 ± 1.54) were captured up to the 14th day. The µD's vertical displacement mechanism was employed to adjust the optrode's depth by 200 µm, which resulted in minimal alterations in amplitude, firing rate, and SNR. Furthermore, consistent neural clusters were observed post-adjustment. We were also able to identify neural units whose firing rates were modulated by the stimulation protocol.

# Hackathon

# HACKATHON

🧠Are you ready for a new challenge?

During the afternoon, **between 15:00 and 18:00** we are preparing a new kind of program for you. We organize a hackathon, where divided into teams, you can work on a practical solution to a specific problem and come up with new ideas together. **The topic is secret**, and will be revealed only at the start of the hackathon. With the registration **we will assign you into a team** with whom you will work together during the hackathon. **This program aims to strengthen effectiveness and collaboration in newly formed groups.** And in addition, isn't it a great opportunity to build new connections and get to know others ideas?

Time is relatively short, so to make the teamwork even more effective, the program will start with the guidance of an experienced **coach, Péter Illés**, who will give you useful tips that help coordinating the workflow in a newly formed group. You will spend 3 hours full of brainstorming, innovative ideas, problem-solving, collaboration and so much fun. Hopefully, many of you can benefit from these experiences in the future.

**The social event in the evening will start with the closing ceremony of the event, where each team should present their solutions and results in a short pitch**. We will ask the teams to make a presentation of a few slides for this purpose, so it will be good to have at least one laptop or tablet with the team. Other useful equipment will be provided, but keep in mind that the details will only be revealed during the briefing at the beginning of the hackathon.

Be creative, make it fun, grab attention!

Each team will receive a score sheet to rate the other teams performance. So the best teams will be voted by the community and will be announced on the MITT gala dinner.

Join us for a day of ideas, inspiration, innovation and most importantly TEAMWORK! 🚀